

Systematics of the Tribe Abraxini (Lepidoptera, Geometridae, Ennominae) in South Korea

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Abstract The following 12 species, belonging to five genera, of the tribe Abraxini in South Korea are reviewed: seven *Abraxas* Leach (*grossulariata* Linnaeus, *sylvata* Scopoli, *niphonibia* Wehrli, *fulvobasalis* Warren, *latifasciata* Warren, *miranda* Butler, and *pseudomiranda* sp. nov.); one *Ligdia* Guenée (*japonaria* Leech); one *Lomaspilis* Guenée (*marginata* Linnaeus); one *Peratophyga* Warren (*hyalinata* Kollar); and two *Heterostegane* Hampson (*hyriaria* Warren and *cararia* Hübner). The cladistic analysis of the Abraxini is tried with 11 taxa using 29 morphological characters. The cladogram based on the successive weighting approach is selected to be a best one. The monophyly of Abraxini and that of four genera, *Abraxas*, *Ligdia*, *Lomaspilis*, and *Peratophyga*, are discussed. The generic relationships of the Abraxini are as follows: (*Eutoea* (*Heterostegane hyriaria* (*Ligdia* (*Lomaspilis*, *Heterostegane cararia*)))), (*Peratophyga*, *Abraxas*). The genus *Heterostegane* is a polyphyletic taxon. The distribution maps of the seven species of *Abraxas* in South Korea are provided.

Key words Systematics, Lepidoptera, Geometridae, Ennominae, Abraxini, Korea

INTRODUCTION

The tribe Abraxini, a tribe of the subfamily Ennominae, is distributed in the Palaearctic and Indo-Australian regions. The Abraxini comprises mainly the genus *Abraxas* Leach and several genera, but the number of genera is different depending on regions. For example, in Central Europe, Herbuleot (1961-62) listed five genera for Abraxini: *Abraxas*, *Calospilos* Hübner, *Lomaspilis* Hübner, *Ligdia* Guenée, and *Lomographa* Hübner. In Taiwan Inoue (1992) included four genera: *Abraxas*, *Hydatocapnia* Warren, *Peratophyga* Warren and *Heterostegane* Hampson. In the former U.S.S.R. Viidalepp (1996) listed four genera: *Abraxas*, *Lomaspilis*, *Ligdia* and *Stegania* Guenée. Thus, the tribe Abraxini sensu Inoue and Viidalepp comprises about six genera from Asia: *Abraxas*, *Lomaspilis*, *Ligdia*, *Peratophyga*, *Stegania*, and *Heterostegane*.

In North American Abraxini Forbes (1948) listed two genera, *Heliomata* Grote and Robinson and



Figs 1-2. Species of *Abraxas* rest on leaves during day-time: 1. *A. grossulariata conspurcata*; 2. *A. fulvobasalis*.

Protitame McDunnough, and diagnosed the tribe by the following characters: antenna simple or subpectinate; no fovea or oblique ridge; costa of male genitalia a long free process; juxta simple; gnathos simply hooked; pupa various; larva with sucker on prolegs. He commented on the origin of the tribe as Old-World.

Holloway (1993), however, proposed that both New-World genera, *Heliomata* and *Protitame*, would be included in the Eutoeini, Macariini and Cassymini. At the same time, he included the three genera, *Lomasplilis*, *Peratophyga* and *Heterostegane*, in Cassymini. Thus the Korean Abraxini has been divided into two tribes, Abraxini sensu Holloway and Cassymini.

In Korea 14 species, belonging to five genera, are listed for Abraxini sensu Viidalepp (Shin, 1996): eight *Abraxas* (*grossulariata* Linnaeus 1758, *karafutonis* Matsumura 1925, *sylvata* Scopoli 1762, *niphonibia* Wehrli 1935, *fulvobasalis* Warren 1894, *latifasciata* Warren 1894, *macularia* Herz 1905, and *miranda* Butler 1878); one *Lomasplilis* (*marginata* Linnaeus 1758); two *Ligdia* (*japonaria* Leech 1897 and *adustata* Denis and Schiffermüller 1775); one *Peratophyga* (*hyalinata* Kollar (1844); and two *Heterostegane* (*hyriaria* Warren 1894 and *cararia* Hübner 1790).

The first purpose of the present study is to find the monophyly of the tribe Abraxini sensu Viidalepp and to diagnose each genus of Abraxini in Korea, using the external morphology and genitalia. The second purpose is to resolve the relationships among the five genera of Korean Abraxini, because the relationships among these genera are unknown.

Also, the identification of *Abraxas* using the external morphology caused many problems due to the variations in wing maculation. Thus, the third purpose is to clarify the species of *Abraxas* using the genitalia, and is to map their distributions in Korea.

MATERIAL AND METHODS

The material examined in this study was largely based on the collection in Kyung Hee University, Seoul, and also on the private collections and institution. The abbreviations of collections and localities

used in this study are as follows: KHUS- Kyung Hee University, Seoul; FRI- Forestry Research Institute, Seoul; KSS- private collection of Sung-Soo Kim, Seoul; JHC- private collection of Heon-Cheon Jeong, Kwangju; HB- Hamkyung Buk-do; GG- Gyonggi-do; GW- Gangwon-do; CB- Chungchong Buk-do; CN- Chungchong Nam-do; GB- Gyungsang Buk-do; GN- Gyungsang Nam-do; JB- Jeolla Buk-do; JN- Jeolla Nam-do and JJ- Jeju-do.

In the present study, 11 of 14 species were examined using the external morphology and genitalia. The remaining three species were not included due to the lack of material and to the questionable records in South Korea. The identification of species was based on Inoue's works (1970, 1972, 1982), because we did not examine the type species. The general procedure of dissecting genitalia including evertting vesica followed Hardwick (1950). The terminology of external morphology including genitalia followed that of Inoue (1970, 1972) and Holloway (1993).

PHYLOGENY

Methods

A cladistic analysis was carried out using 11 taxa of the Abraxini and two outgroups from the tribe Gonodontini, *Gonodontis clelia* Cramer and the tribe Eutoeini, *Eutoea heteroneurata* Guenée, respectively. The selection of the outgroups was based on the close relationship between Abraxini, Gonodontini and Eutoeini (Holloway, 1993). 29 characters were recognized (see Appendix 1), 12 of them being multistate characters. Character coding of two outgroups was based on the figures shown in Holloway (1993). Missing characters due to the lack of specimen were coded as unknown and were used hyphens (-). In the analysis the multistate characters were treated as an unordered.

For a cladistic analysis of the data matrix of the Korean Abraxini, NONA (Ver. 1.5; Goloboff, 1993) was used. The command used to find most parsimonious cladograms was "hold*,hold/30;mult*25". The successive weighting approach (Farris, 1969) was applied by Hennig86 (Ver. 1.5; Farris, 1988).

Results

The first analysis with NONA using 29 morphological characters produced five most parsimonious cladograms with length of 69, consistency index of 0.68 and retention index of 0.73. The successive weighting approach (Farris, 1969) was applied for these five cladograms and this produced one cladogram (Fig. 3). For the best cladogram, we selected the cladogram produced from successive weighting approach because this was identical with one of the five cladograms (Fig. 4).

The monophyly of the tribe Korean Abraxini sensu Holloway is not supported. The monophyly of Cassymini is not supported, either. However, the basal clade comprising Abraxini, Cassymini and Eutoeini were supported by four synapomorphies: broad and rounded saccus (#13-0), rod-shaped and straight costal arm of valva (#14-0), tubular vesica (#22-0), and filiform male antenna (#28-1).

The monophyly of each genus of the Abraxini was supported by several apomorphies, except *Heterostegane* that was found as a polyphyletic taxon. The genus *Abraxas* was supported by eight

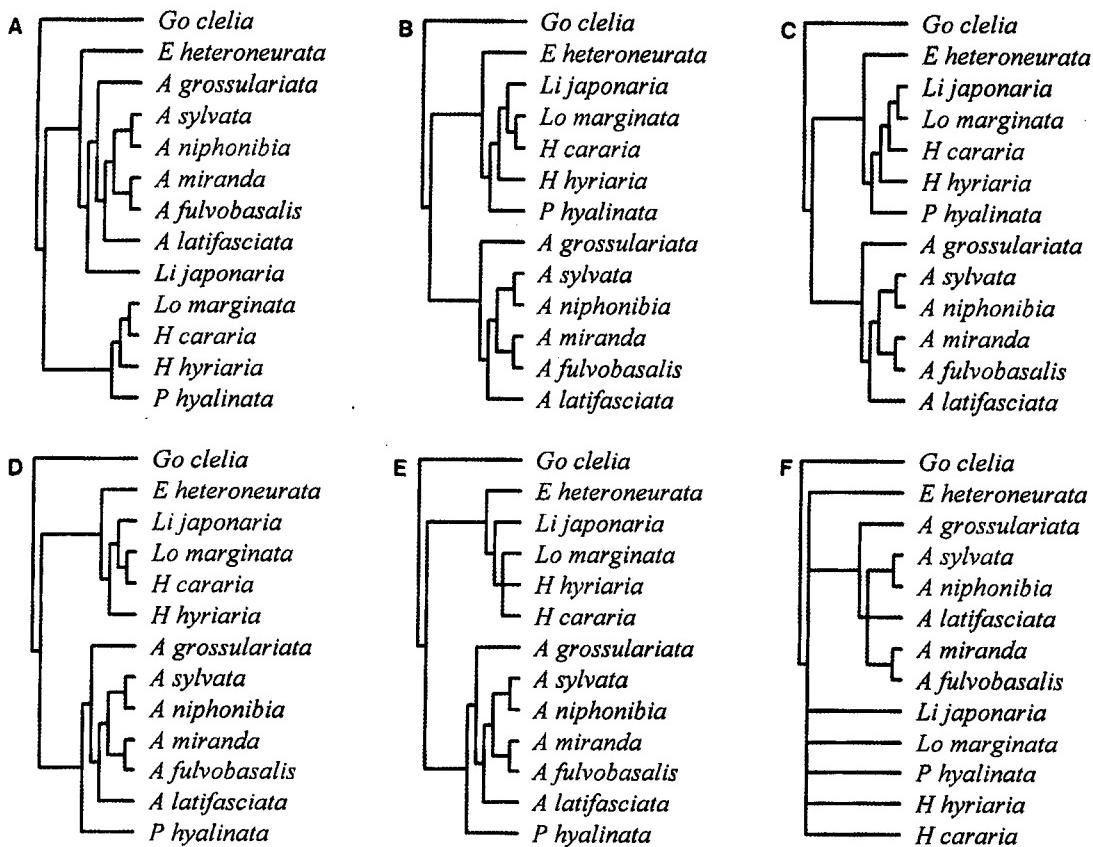


Fig. 3. Cladograms produced by NONA using 11 taxa and 29 morphological characters for the Korean Abraxini. Two outgroups are used: *Gonodontis clelia* and *Eutoea heteroneurata*. Cladograms A-E are the five most parsimonious cladograms, and F is the strict consensus cladogram of A-E. Abbreviations of genera: Go. *Gonodontis*, E. *Eutoea*, Li. *Ligdia*, Lo. *Lomaspilis*, H. *Heterostegane*, A. *Abraxas* and P. *Peratophyga*.

synapomorphies: male forewing fovea absent (#0-1), forewing basal part prominent (#2-0), hindtibia expanded (#5-1), abdomen distinct by black dots (#6-1), ampulla with dentate processes (#18-1), harpe with process (#19-1), aedeagus with long caecum (#20-1), and absence of cornutus (#23-0).

The monophyly of *Peratophyga* was supported by six synapomorphies: wings medially without band or dots (#3-1), forewing termen with blackish thick band (#4-0), gnathos triangular (#10-0), valva costal arm medially encurved, the upper arm with a tail (#14-2), costal margin flat (#15-1), and aedeagus distally with two processes (#21-2).

The monophyly of *Lomaspilis* was supported by five synapomorphies: forewing basally with a horizontal black bar (#2-1), wings medially with black dots or band (#3-0), forewing termen with blackish thick band (#4-0), gnathos ring-shaped (#10-1), and vesica large, sac-like (#22-1).

The monophyly of *Ligdia* was supported by four synapomorphies: forewing basally prominent (#2-0), abdomen distinct by black dots (#6-1), forewing subterminal band dorsally prominent (#7-1), and

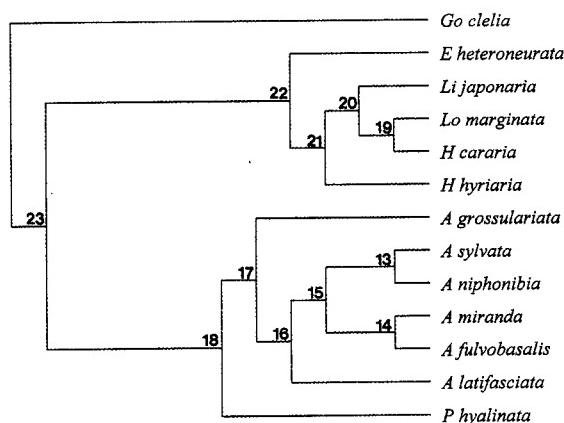


Fig. 4. The best cladogram of Korean Abraxini. Each node accompany the node number. The synapomorphies supporting each node are shown in Table 1. Abbreviations of genera, see Fig. 3.

Table 1. A list of the synapomorphies supporting the branches of the selected cladogram, shown in Fig. 4. Each node presents characters with derived character state in the node. For description of character and character states, see Appendix 1.

Node	Character and state change
23	13(0), 14(0), 22(0), 28(1)
22	23(2), 26(0)
21	0(1), 3(1), 11(0)
20	14(1)
19	13(1)
18	12(1)
17	0(1), 2(0), 5(1), 6(1), 18(1), 19(1), 20(1), 23(0)
16	7(1), 8(0)
15	24(2), 25(3), 26(1)
14	18(0)
13	13(1), 17(1), 21(1)

gnathos triangular (#10-0).

The monophyly of *Heterostegane* was found as polyphyletic taxon. *H. hyriaria* had five autapomorphies, male forewing fovea present (#1-0), saccus with long well-developed furca (#13-2), ampulla with process (#18-1), harpe with process (#19-1), and cornutus one, large spinular (#23-1), whereas *H. cararia* had four autapomorphies, uncus tip bifurcated (#8-2), uncus basally flap-like projections (#9-2), cornuti several, small processes (#23-3), and ductus bursae long, inner wall with sclerite processes (#27-2).

The generic relationships were as follows: (*Eutoea* (*Heterostegane* *hyriaria* (*Ligdia* (*Lomaspilis*, *Heterostegane* *cararia*)))) and (*Peratophyga*, *Abraxas*). The first clade was supported by two apomorphies, cornuti several and large (#23-2) and antrum short and not strongly sclerotized (#26-0), whereas the second clade by one apomorphy, juxta basally with pit-like projections (#12-1).

Discussion

Although the extent of the tribe Abraxini sensu Holloway is not clear, the monophyly is discussed (Holloway, 1993). The Korean Abraxini sensu Viidalepp included five genera, *Abraxas*, *Lomaspilis*, *Ligdia*, *Peratophyga* and *Heterostegane*, and the common characters among these genera are as follows: whitish ground color of wings; filiform male antenna; short palpi; presence of setal combs on male's third abdominal sternite; and well-developed costal arm of male genitalia. However, the cladistic analysis reveals that the Abraxini sensu Holloway is not monophyletic and suggests that Abraxini should include the following tribes as well: Cassymini and Eutoeini.

The generic relationships among the members of the Korean Abraxini are revealed. *Ligdia* is close to *Abraxas* in the wing pattern element and the absence of fovea in forewing. It suggests that *Ligdia* might be a group of the Abraxini (Holloway, 1993). However, *Ligdia* can be included in the remaining four genera than *Abraxas* based on the genitalia, such as the presence of ampulla, harpe and sterigma. The cladistic analysis shows that *Peratophyga* is grouped with *Abraxas* by one character, and *Ligdia* is close to *Lomaspilis* and *Heterostegane*.

Heterostegane is not monophyletic taxon. In the present analysis, the two species of *Heterostegane* were used. Although the wing pattern elements of them are similar to each other, they can be easily separated by the male abdomen and the genitalia: male third abdominal sternite with setal combs, and the shapes of uncus, saccus, costal arm, ampulla, harpe, and cornuti. It led to the genus *Heterostegane* as polyphyletic. However, we do not make any taxonomic decision in this study because we do not include the type species, *H. subtessellata* Walker, and the genus is most diverse in the Oriental region. Also, one of the five cladograms showed that *Heterostegane* is a monophyletic taxon. Thus, the future study using the type species and many Oriental species may clarify the monophyly of the genus.

The relationship between the two subgenera, *Abraxas* s. str. and *Calospilos*, is also of interest. This is because these two groups can be separated by several characters, such as the presence of subterminal dorsal blotch of wings, the well-developed gnathos and the dentate costal process of male genitalia, although these two groups show the similar structure of female genitalia. This has led to two different points of view: two subgenera (e.g. Inoue, 1972, 1984, 1995), or one genus with the junior synonym of *Calospilos* (e.g. Holloway, 1993; Viidalepp, 1996). Based on the present study, there are good differences between the two subgenera, but they were combined into a single genus by the distinct coloration of wings, abdomen and the genitalia. Thus, the monophyly of *Abraxas* is shown.

TAXONOMY

Tribe Abraxini Warren, 1893

Diagnosis and monophyly. According to Holloway (1993), the members of the Abraxini are similar to related tribes, Eutoeini, Macariini and Cassymini, in the male's third abdominal sternite by having a setal comb and lacking the socii in male genitalia. However, the tribe Abraxini is distinguished from related taxa by the following characters: ciliate male antenna; small tympanic cavi; yellowish thorax and abdomen (and often wing bases) bearing a complex array of dark maculae, contrasting with white ground color of

wings.

The tribe Abraxini is a monophyletic taxon, although the extent of the tribe is uncertain (Holloway, 1993). The tribe is defined mainly by the male genitalia, especially by the valval structure: valva with dorsal (costal) process digitate and ventral portion very large, rounded, or triangular, with ornamentation often on both dorsal and ventral margins; a weak or absent gnathos; lack of coremata; normal chaetosemata (Holloway, 1993).

Holloway (1993) erected a new tribe Cassymini by the common possession of a long, slender process arising from the base of the dorsal margin of the valve, followed from Fletcher (1974). In addition Holloway listed the apomorphic characters: the presence of fovea and the reduced number of radial veins of forewing.

In the present study, the monophyly of the Abraxini s. lat. is shown (see above).

Description. Adults: Antenna of both sexes filiform; frons broad, covered by brownish or yellowish white scales; labial palpus short, being less than eye diameter. Legs normal, with brownish or mixed with brown and yellow scales, often hindtibia expanded (*Abraxas* in part), forewing ground color white (*Abraxas*, *Ligdia*, *Lomaspilis*) or yellowish white (*Peratophyga*, *Heterostegane*); basal part distinct by reddish black and ochreous area (*Abraxas*, *Ligdia*), light blackish (*Peratophyga*), blackish horizontal bar-shaped band (*Lomaspilis*); medial band with blackish dots, often costal dot and central dot united and formed a short band (*Abraxas*, *Lomaspilis*), with a round black dot (*Ligdia*), or small discal dot (*Heterostegane*); subterminal line well-developed, a transverse band (*Abraxas*, *Ligdia*) or thin line with centrally extended to termen (*Heterostegane*); termen covered by blackish band, centrally expanded (*Abraxas*), indented (*Lomaspilis*), scalloped (*Peratophyga*), or thinly lined (*Heterostegane*). hindwing ground color white (*Abraxas*, *Ligdia*, *Lomaspilis*) or yellowish white (*Peratophyga*), or greyish (*Heterostegane*); basal part with small black dots (*Abraxas*) or light blackish line (*Peratophyga*); medial part with black dots, united and formed a transverse line (*Lomaspilis*, *Abraxas* in part), or small dots separated (*Ligdia*, *Abraxas* in part), or small brownish discal dot (*Heterostegane*); subterminal part well-developed with thick blackish band (*Ligdia*), or two parallel lines of dots, often united and formed a thick transverse line (*Abraxas*), with dorsal blotch (*Abraxas* in part), or thin line (*Heterostegane*); termen with thin blackish band (*Abraxas*, *Lomaspilis*), or thinly lined (*Heterostegane*), or thick light blackish band (*Peratophyga*), or dots (*Ligdia*).

Male abdomen and genitalia. Third abdominal sternite with setal combs, sometimes absent (*Heterostegane* in part). Uncus short or moderate in length, often basally with processes or plate-like structure (*Abraxas*); gnathos well-developed, ring-shaped (*Lomaspilis*), triangular (*Ligdia*, *Peratophyga*); tegumen and vinculum formed a broad and elongate structure (*Abraxas*), rather shorter (*Lomaspilis*, *Ligdia*), or vinculum well-developed (*Heterostegane*); saccus broad or medially projected; juxta sclerotized, posterior part with basal processes (*Abraxas* in part, *Peratophyga*), or with large sclerotized furca (*Heterostegane*). Valva sclerotized, wider than length (*Abraxas*); costal arm elongate, slender, often basally expanded, medially curved, tip with minute spine; costa with sclerotized processes (*Abraxas*), medially greatly invaginated (*Lomaspilis*, *Peratophyga*); valvula centrally projected (*Lomaspilis*, *Heterostegane*), bifurcate (*Ligdia*, *Abraxas* in part) or truncate (*Abraxas* in part); ampulla and harpe well-developed with dentate processes (*Abraxas*). Aedeagus slender, elongate, with long caecum

(*Abraxas*); distal part sclerotized, with a process (*Abraxas*); vesica tubular (*Abraxas*) or large sac-like (*Lomaspilis*, *Ligdia*); cornuti spinular process present (*Lomaspilis*, *Ligdia*, *Peratophyga*, *Heterostegane*), or absent (*Abraxas*).

Female genitalia. Papillae anales simple, normal; anterior apophyses usually half length of posterior apophyses; sterigma with well-developed lamella antevaginalis and postvaginalis (*Abraxas*), simple (*Lomaspilis*, *Ligdia*); antrum long, sclerotized, parallel-sided or posterior part broader than anterior part (*Abraxas*), or short (*Lomaspilis*). Ductus bursae short and scobinate (*Abraxas*), long and sclerotized with striations (*Lomaspilis*, *Ligdia*); corpus bursae ovate (*Abraxas*, *Lomaspilis*), slender (*Ligdia*); signum large, prominent with stellate process (*Abraxas*, *Lomaspilis*), absent (*Ligdia*).

Host plants. Pinaceae, Caprifoliaceae, Ericaceae, Fagaceae, Oleaceae and Saliaceae (Holloway, 1993).

Distribution. Palaearctic and Indo-Australian region, but most diverse in the latter region.

Key to the genera of Abraxini in Korea

1. forewing with a well-developed subterminal band 2
- forewing without a subterminal band 5
2. The subterminal band of both fore and hindwings with a reddish brown blotch at dorsum; gnathos not developed *Calospilos* s.str.
– The subterminal band without a reddish brown blotch at dorsum; gnathos developed 3
3. The subterminal band of forewing consisted of two parallel transverse bands; costa of male genitalia with process; ampulla and harpe with dentate process; sterigma of female genitalia developed; ductus bursae of female genitalia short and not striated *Abraxas* s. str.
– The subterminal band consisted of a single transverse band; costa without process; harpe not developed; sterigma not developed; ductus bursae long and striated 4
4. The subterminal band of forewing thick; the basal area of forewing prominent; gnathos developed with triangular-shaped structure; juxta normal without furca; valva distally bifurcate *Ligdia*
– The subterminal band of forewing thin, brownish; the basal area of forewing not prominent; gnathos absent; juxta with long furca; valva medially projected *Heterostegane*
5. The termen with a thin blackish band with medially indented; gnathos not elongate; costal arm not divided into two parts; saccus medially strongly projected; vesica large, sac-like *Lomaspilis*
– The termen with a thick light blackish band with scalloped inner margin; gnathos elongate, triangular; costal arm divided into two parts, upper arm with a tail; saccus broad, rounded; vesica tubular *Peratophyga*

Systematic account

***Abraxas* Leach, 1815**

- = *Spilota* Hübner, 1822, Syst. alphab. Verz.: 39–43, 45–47, 51.
- = *Calospilos* Hübner, 1825, Verz. bekannter Schmett.: 305.

- = *Zerene* Treitschke, 1825, in Ochsenheimer, Schmett. Eur. 5(2): 444.
- = *Potera* Moore, 1879, Proc. zool. Soc. Lond. 1878: 852.
- = *Omophyseta* Warren, 1894, Novit. zool. 1: 414.
- = *Silabraxas* Swinhoe, 1900, Cat. east. and Aust. Lepid. Heterocera Colln Oxf. Univ. Mus. 2: 305.
- = *Chooreechillum* Lucas, 1901, Proc. R. Soc. Qd. 16: 73.
- = *Isostictia* Wehrli, 1934, Ent. Z., Frankf., a.M. 48: 139.
- = *Dextridens* Wehrli, 1934, Ent. Z., Frankf., a.M. 48: 140.
- = *Mesohypoleuca* Wehrli, 1935, Int. ent. Z. 29: 1.
- = *Rhabdotaedoeagus* Wehrli, 1935, Ent. Rdsch. 52: 101.
- = *Spinuncus* Wehrli, 1935, Ent. Z., Frankf., a.M. 48: 162.
- = *Diceratodesia* Wehrli, 1935, Ent. Rdsch. 52: 117.
- = *Trimeresia* Wehrli, 1935, Ent. Rdsch. 52: 119.

Type species. *Phalaena grossulariata* Linnaeus, 1758, by subsequent designation by Curtis, 1834, Br. Ent. 11: 515. Type locality: Not stated, but probably Europe (Fletcher, 1979).

Historical review. Prout (1915) diagnosed the genus *Abraxas* using the following characters: smooth face; short, rough-scaled palpi; male antenna thick with appressed serration; dilated male hindtibia; weak, not densely scaled wings; absence of fovea; 1st subcostal vein of forewing arising from 2nd and running into costa, or exceptionally absent. Wehrli (1939) divided this genus into ten subgroups, *Mesohypoleuca*, *Dextridens*, *Isosticta*, *Spinuncus*, *Abraxas*, *Calospilos*, *Rhabdotaedoeagus*, *Empriononyx*, *Diceratodesia*, and *Trimeresia*. However, Inoue (1970) reclassified these 10 subgenera into two subgenera: *Abraxas* s. str. comprising the first five subgenera and *Calospilos* the last five subgenera. The main differences between these two subgenera were tabulated (Inoue, 1970): inner marginal blotch of forewing of *Abraxas* absent but that of *Calospilos* present; socii of *Abraxas* strongly sclerotized plate but that of *Calospilos* membranous; uncus of *Abraxas* short and apex tapered but that of *Calospilos* very long stick, with swollen rounded apex; gnathos of *Abraxas* ring-shaped but that of *Calospilos* absent or an incomplete ring-shaped. In addition, Inoue (1972) separated the two subgenera based on the life cycle: *Abraxas* mainly univoltine, but *Calospilos* bivoltine or trivoltine. Holloway (1993) diagnosed the species of each subgenus as follows: *Abraxas* s. str. a fairly punctate, delicate pattern, lack of a strong inner marginal blotch on the forewing, the uncus arising from a broad basal plate and the gnathos present as a ring; *Calospilos* the wing pattern strong, blotch, with a strong inner marginal blotch, the uncus narrow or laterally membranous at the base and apically bulbous, and the gnathos absent.

Diagnosis. The species of *Abraxas* are identified by the following morphology, especially by the wing pattern and abdomen: filiform antenna in both sexes; simple, broad and brownish frons; short labial palpus; basal part of forewing mixed with reddish brown and ochreous bands; medial band costally with a black band, centrally with small dots, sometimes connected to costal band or separated; subterminal band consisted of two transverse dots, with a dorsal blotch; termen blackish with centrally expanded; subterminal band of hindwing consisted two transverse dots, with a reddish brown blotch; abdomen yellowish with black dots on tergum, sternum and pleuron.

The male genitalia of *Abraxas* can be recognized by the following characters: uncus basally tapered,

sometimes with basal processes (*latifasciata*) or large flap-like process (*grossulariata*), or absent; tegumen and vinculum formed a broad, elongate structure; juxta sclerotized basally with a pair of pit-like invaginations; rod-shaped costal arm, sometimes with basally expanded, medially curved; ampulla and harpe well-developed with dentate processes; slender aedeagus with long caecum; tubular vesica, sometimes expanded at base; absence of cornutus.

The female genitalia of *Abraxas* can be recognized by the following characters: well-developed sterigma; long and sclerotized antrum; short ductus bursae with scobinate process; ovate corpus bursae with a stellate signum.

Biology. In Japan, the species of *Abraxas* are mainly bivoltine and hibernates as a pupa (Sato and Nakajima, 1987).

Distribution. Palaearctic and Indo-Australian. In South Korea, the examination of the genitalia and external morphology reveals that seven species of *Abraxas* including one new species, *A. pseudomiranda*, are distributed (Figs. 24–26).

The distributional pattern of these seven species shows that the three species (*grossulariata*, *niphonibia*, and *latifasciata*) occur widely in South Korea, but *sylvata* occurs in the mountain areas of the northeastern South Korea. The distribution of two species *miranda* and *pseudomiranda* can be divided into the central and southern part of South Korea, respectively. But, this hypothesis needs more studies.

***Abraxas grossulariata* (Linnaeus) 줄노랑얼룩가지나방 (Figs 1, 5–6, 27)**

Phalaena grossulariata Linnaeus, 1758, Syst. Nat. (ed. 10) 1: 525.

Abraxas grossulariata: Staudinger, 1871, in Staudinger and Wocke, Cat. Lep. p. 154.

Abraxas grossulariata var. *minor* Herz, 1905, Ezheg. zool. Muz. 9: 353.

Abraxas grossulariata memorabilis Inoue, 1946, Bull. lepidopt. Soc. Japan 1: 12.

Abraxas conspurcata Butler, 1878, Ann. Mag. nat. Hist. (5)1: 440.

Abraxas grossulariata conspurcata: Prout, 1915, in Seitz, Grossschmett. Erde 4: 310; Hyun and Woo, 1969, Bull. Seoul Nat'l Univ. Forest 6: 171; Inoue, 1972, Bull. Fac. domestic Sci., Otsuma Woman's Univ. 8: 142.

Abraxas grossulariata: Ko, 1969, A list of forest insect pests in Korea, p. 102.

Diagnosis. *Abraxas grossulariata* is identified by the larger size and the subterminal band of forewing that shows two blackish bands and a yellowish band between these two bands. This species is similar to *sylvata*-group, but differs in the absence of dorsal blotch of forewing. In the male genitalia, the ring-shaped gnathos and the costa with a dentate projection are distinct and in the female genitalia, the sterigma is distinct: lamella antevaginalis is a triangular projections and the lamella postvaginalis is a plate-like, sclerotized structure.

Redescription. Adults: Wingspan 35–42 mm. Frons simple, covered by brownish scales; labial palpus short, being less than eye diameter. Legs yellow, midleg mixed with yellow and black, hindtibia expanded. forewing basal part with two blackish bands and yellow band between these bands; medial band costally

short blackish band or two distinct dots, often this band or lower dot meets to subterminal band, dorsally a black dot; subterminal band with two parallel bands, the inner one black, band-shaped, the outer one lined by black dots, and yellow band between two black bands; termen lined by black dots. hindwing ground color white; medially a black dot; subtermen two parallel transverse bands lined by dots, often dorsally yellowish between two bands; termen lined by black dots.

Male genitalia. Uncus short, basally with flap-like sclerotized projections; tegumen and vinculum long, parallel-sided; juxta two sclerotized bands, basally pit-like projections; saccus broad, with a medial projection. Valva sclerotized; costal arm long, rod-shaped, inner surface basally slightly expanded; costa medially with projections; valvula truncated, slightly bifurcate; ampulla with small dentate processes, often a large process; harpe elongate with a distal projection. Aedeagus long, slender, apically sclerotized with a process; caecum long, digitiform; vesica tubular, without cornutus.

Female genitalia. Papillae anales normal, basally sclerotized; anterior apophyses 1/3 as long as posterior apophyses. Sterigma prominent; lamella antevaginalis with a pair of small projections; lamella postvaginalis sclerotized with laterally thickly sclerotized; antrum long, sclerotized, bottle-shaped; ductus bursae short, membranous; corpus bursae ovate, simple, membranous; signum prominent, stellate.

Material examined. [GW] 1 ♂, Mt. Sorak, 14.VII.1983 (KHUS); 1 ♂, Mt. Paekdok, 3.VII.1985; 1 ♀, Mt. Chaeon, 26.VI.1998 (KSS); 1 ♀, Mt. Taebaek, 24.VII.1987. [CN] 1 ♀, Kapsa, Mt. Kyeryong, 3.VI.1980. [JB] 1 ♂, Kuchondong, Muju, 27.VII.1976; 1 ♂, Piagol, Mt. Chiri, 6.VII.1982 (KHUS). [JN] 2 ♂, Paekyangsa, 6.VI.1996 (JHC).

Biology. In Japan the species is polyphagous on *Viburnum*, *Fraxinus*, *Vaccinium*, *Enkianthus*, *Menziesia*, *Euonymus*, *Fagus*, *Salix*, and *Abies*. This species is univoltine and hibernates as a larva (Inoue, 1972).

Distribution. Korea, Japan, and NE. China.

Remarks. In Korea Inoue (1972) listed three subspecies, *minor* Herz, *memorabilis* Inoue and *conspurcata* Butler. For the systematic account on these subspecies, Prout (1915) and Wehrli (1939) pointed out the differences between the nominate subspecies and a subspecies, *conspurcata*, and treated the latter as valid. Although there are many morphological differences among them, Inoue (1972) suggested the latter should be treated as the subspecies and diagnosed it as follows: "smaller, forewing with orange postmedian line in general thicker, hindwing with antemedial black band developed, postmedian double rows of black spots completely, sometimes incompletely developed."

The subspecies, *memorabilis*, can be diagnosed by the heavy markings of forewing on the subbasal, postmedial and marginal rows of spots (Inoue, 1946), whereas the subspecies, *minor*, can be diagnosed by the smaller size (Prout, 1915).

In the present study the wing pattern elements, especially in the medial band of hindwing divided the Korean specimens into the nominate subspecies and *conspurcata*. But the male genitalia of both specimens were identical to *conspurcata*. The specimen that has the similar wing pattern element to the nominate subspecies may be included in *ribesata* Staudinger (cf. Inoue, 1972). The designation of these subspecies to the species level needs a careful consideration due to continuous variation of the distal part of valva.

The two subspecies, *memorabilis* and *minor*, might be a melanic or aberration form.

***Abraxas karafutonis* Matsumura** 북방열록가지나방

Abraxas karafutonis Matsumura, 1925, J. Coll. Agric. Hokkaido imp. Univ. 15(3): 162, pl. 11: 3.

Abraxas heringi Kardakoff, 1928, Ent. Mitt. 17: 421; Inoue, 1972, Bull. Fac. domestic Sci., Otsuma Woman's Univ. 8: 144.

Remarks. In Korea Vojnits et al. (1994) first recorded this species with 47 specimens from Samji-yon, Mt. Peakdu. In the present study, we have not examined this species due to the lack of a specimen.

Distribution. Korea (N.), Russian Far East (Sakhalin).

***Abraxas latifasciata* Warren** 참빗살열록가지나방

(Figs 15–19, 28)

Abraxas latifasciata Warren, Novit. zool. 1: 419.

Abraxas miranda latifasciata, Prout, 1915, in Seitz, Grossschmett. Erde 4: 311.

Abraxas suspecta japonibia Wehrli, 1935, Ent. Rdsch. 52: 101; Inoue, 1972, Bull. Fac. domestic Sci., Otsuma Woman's Univ. 8: 152.

Abraxas suspecta latifasciata Wehrli, 1935, Ent. Rdsch 52: 168.

Calospilos suspecta japonibia: Inoue, 1956, Check List Lep. Japan 3: 299.

Calospilos suspecta latifasciata: Inoue, 1956, Check List Lep. Japan 3: 299.

Abraxas (Calospilos) latifasciata: Inoue, 1972, Bull. Fac. domestic Sci., Otsuma Woman's Univ. 8: 152.

Diagnosis. This species is similar to *miranda*, but differs in the well-developed ampulla with dentate processes and triangular and less pointed harpe of male genitalia. In female genitalia the sterigma and antrum can separate this species from *miranda*: undeveloped lamella postvaginalis and lamella antevaginalis thin, horizontal long process; and long antrum.

Redescription. Adults: Wingspan 37–42 mm. Frons broad, covered by yellowish scales; labial palpus short, less than eye diameter, with yellowish 1st segment and brownish 2nd and 3rd segments. Legs normal, with yellowish foreleg and brownish mid and hindlegs. forewing basal part large and prominent by yellowish and reddish brown scales; medial band usually costal large dot and dorsal dots, often these dots united to form band, with a reddish brown circular dot on discal cell; subterminal band blackish, costally thicker and centrally narrowed, dorsally with large ochreous and black blotch; termen covered by thin black band, centrally expanded, often costally blackish. hindwing ground color white; basal part with black dot; medial band costally with black short band, dorsally with black dots, often medial band formed single band; subterminal band two parallel bands, each band lined by black dots, usually two bands united, dorsally with ochreous and reddish brown blotch; termen thinly black, often between subterminal band and termen with small dots.

Male genitalia. Uncus basally tapering with a pair of minute processes, tip expanded; tegumen and vinculum broad, elongate, parallel-sided; juxta sclerotized, basally with pit-like invaginations; saccus medially projected. Valva strongly sclerotized; costal arm rod-shaped, basal part thicker than distal part,

medially curved; ampulla with dentate processes; harpe greatly expanded, triangular; valvula with medial projection. Aedeagus slender, rod-shaped, distally sclerotized, truncate, broader than basal part; vesica tubular, without cornutus.

Female genitalia. Papillae anales normal; anterior apophyses thick, half as long as posterior apophyses; sterigma simple, sclerotized; lamella antevaginalis thin, horizontal process; antrum long, sclerotized, posterior part broader than anterior part. Ductus bursae short, inner wall with scobinate; corpus bursae ovate; signum large, prominent with horn-like dendrites.

Material examined. 1 ♂, Seoul, 4.IX.1985 (KSS). [GG] 3 ♂, Gwangleung, 16.VIII.1984 (KSS), 24.V.1988 (FRI); 4 ♂, Mt. Keomdan, 23.V.1998 (KSS); 1 ♂, Mt. Jukyop, 18.V.1989 (KSS); 2 ♀, Mt. Chugum, 10.VI.1984, 11.VI.1995 (KSS); 1 ♂, 1 ♀, Mt. Chonggye, 7.V.1994 (KSS); 1 ♂, Is. Youngjong, 26.V.1995 (KSS). [GW] 1 ♂, Mt. Kariwang, 25.VII.1987 (KSS); 1 ♀, Mt. Paekdok, 5.VII.1985 (KSS); 1 ♀, Mt. Taebaek, 31.VII.1984 (KSS). [CB] 1 ♂, 1 ♀, Mt. Worak, 4.VI.1997. (KSS); 1 ♀, Joryong, 5.IX.1990 (KSS). [JN] 1 ♂, Mt. Mudeung, 1.VI.1994 (KSS); 1 ♀, Mt. Baekun, 17.VIII.1995 (KSS). [JJ] 1 ♀, Seonheul, 22.VII.1993 (KSS); 1 ♂, 1 ♀, Ara-dong, 29.VI.1983 (KSS).

Biology. The species is bivoltine or trivoltine and hibernates as a pupa. For a host plant, the species feed on *Euonymus sieboldiana* Bl. and *E. alatus* (Thunb.) (Celastraceae) (Sato and Nakajima, 1987).

Distribution. Korea, Japan, E. China and Russian Far East (S. Primorye).

Remarks. Inoue (1972) divided the subgenus *Calospilos* into three subgroups and the species *latifasciata* was separated from the remaining species by the presence of basal process at uncus. In addition he noted that this species shows many apomorphic states in both male and female genitalia.

For its distribution in Korea, Inoue (1972) suspected that this species is the commonest species in the central part of Korea. Based on the present study, both *niphonibia* and *latifasciata* are common throughout Korea, but the former is more abundant.

***Abraxas sylvata* (Scopoli) 애기얼룩가지나방**

(Figs 7-8, 30)

Phalaena sylvata Scopoli, 1762, Ent. Carn. p. 220.

Abraxas microtata Wehrli, 1931, Mitt. dtsch. ent. Ges. 2: 107.

Abraxas sylvata microtata, Wehrli, 1935, Ent. Rdsch. 52: 101, pl. 1: 10.

Abraxas (Calospilos) sylvata microtata: Inoue, 1972, Bull. Fac. domestic Sci., Otsuma Woman's Univ. 8: 145.

Calospilos sylvata: Ko, 1969, A list of forest insect pests in Korea, p. 107.

Calospilos sylvata ijimai: Kim, et al. 1975, Rept. KACN 7: 214.

Abraxas sylvata: Shin, 1996, Synonymic list and distribution of the Geometridae of Korea, p. 68.

Diagnosis. The species, *Abraxas sylvata*, can be identified by the wing pattern elements: costal black dot in the medial part of forewing simple, without eye-shaped dot in the middle and the area between basal part and subterminal band of hindwing more or less simple, without transverse line. However, this species is indistinguishable from the following species, *niphonibia*, in wing pattern elements, but differs in

both male and female genitalia. In male genitalia this species (*sylvata*) can be separated by the costal arm, being more slender and straight, and the less projected harpe. In female genitalia, the large and rod-shaped lamella postvaginalis of sterigma and the constant width of antrum separate this species from *niphonibia*.

Redescription. Adults: Wingspan 31–36 mm. Frons broad, covered with reddish black scales; labial palpus short. Legs normal, covered by brownish scales, hindtibia expanded. forewing ground color whitish; basal part prominent by reddish black and ochreous area; medial part costal black dot; subterminal band two parallel transverse dots, with dorsum ochreous and reddish black blotch; termen whitish or thinly blackish, centrally blackish, expanded. hindwing ground color whitish; basal part with black dot; area between basal and subterminal band with small black dots; subterminal band large black parallel transverse dots, with dorsum reddish black and ochreous blotch; termen white.

Male genitalia. Uncus long, basally tapered, tip slightly expanded; gnathos absent; tegumen and vinculum broad, long, parallel-sided; juxta basally with pit-like invaginations; saccus medially projected. Valva strongly sclerotized, wider than length; costal arm rod-shaped; ampulla well-developed with 2 or 3 dentate projections; harpe projected process; valvula dorsally dentates, with bottom one prominent, larger than others; sacculus with hairs. Aedeagus slender, distally sclerotized with a process, caecum long.

Female genitalia. Papillae anales normal; anterior apophyses half length of posterior apophyses; sterigma sclerotized, ventrally with lamella antevaginalis dumbbell-shaped, dorsally with lamella postvaginalis long, rod-shaped process; antrum sclerotized, longer than wide. Ductus bursae membranous, anterior to antrum partly sclerotized; corpus bursae large, ovate; signum prominent, with large, horn-like dendrites.

Material examined. [GW] 1♀, Sambongyaksu sanjang, 23.VII.1981; 5♂, 3♀, Mt. Sorak, 11.VI.1983, 11–13.VII.1983 (KHUS); 2♀, Mt. Odae, 6.VIII.1986. (FRI), 1.VIII.1996. (KSS); 1♂, 1♀, Mt. Chiak, 10.VI.1977, 7.VIII.1977 (KHUS).

Biology. The species is bivoltine and hibernates as a pupa. In Japan *Ulmus lactiniata* (Trautv.) (Ulmaceae) is known as a host plant (Sato and Nakajima, 1987).

Distribution. Known to occur widely in the Palaearctic region.

Remarks. Inoue (1972) expected that this species would occur in Korea. Since him there were several records on this species (e.g. Kim et al. 1975; Park and Han, 1992). However, the validity of these records is uncertain due to the great variations in wing pattern elements and its similarity to *niphonibia*.

The species is rare in the central and southern South Korea, but occurs in the mountain areas of northeastern South Korea, such as Mts. Sorak, Chiak, and Odae.

***Abraxas niphonibia* Wehrli 각시 열룩가지나방**

(Figs 9–13, 31)

Abraxas sylvata niphonibia Wehrli, 1935, Ent. Rdsch. 52: 121, pls. 1: 9, 3: 12.

Abraxas sylvata cos Wehrli, 1935, Ent. Rdsch 52: 121, pl. 1: 7.

Calospilos sylvata cos: Anonymous, 1959, The outline Gwangneung Experiment Forest, p. 89.

Abraxas suspecta liliput Bryk, 1948, Ark. Zool. 41A, 1: 189; Inoue, 1972, Bull. Fac. domestic Sci.,

Otsuma Woman's Univ. 8: 147.

Abraxas (Calospilos) niphonibia: Inoue, 1971, Bull. Fac. domestic Sci., Otsuma Woman's Univ. 7: 165; Inoue, 1972, op. cit. 8: 147.

Diagnosis. This species is very similar to *sylvata* in the wing pattern elements and the genitalia, but differs in the male genitalia in which the harpe is large and triangular and the costal arm is expanded at base and curved at middle. In female genitalia the small, broad and tongue-shaped lamella postvaginalis of sterigma and the shape of antrum, not parallel-sided and posterior part broader than anterior part, can separate this species from *sylvata*.

Redescription. Adults: Wingspan 32–36 mm. Legs as in *sylvata*. forewing basal part and subterminal band as in *sylvata*; medial part costally with black dot irregular in shape, inside with black eye-shaped dot, centrally and dorsally with black dots; termen thinly blackish band, centrally expanded. hindwing basal part with black dot; area between basal part and subterminal band with black dots, often forming transverse band; subterminal band large parallel transverse dots; termen lined by black dots.

Male genitalia. Uncus, tegumen, vinculum and saccus as in *sylvata*. Valva costal arm basally expanded, medially curved; ampulla with tooth-like processes; harpe large, triangular process with tip pointed; valvula dorsally with small processes, often the bottom one larger than others. Aedeagus as in *sylvata*.

Female genitalia. Papillae anales normal; anterior apophyses half as long as posterior apophyses; sterigma sclerotized, ventrally with lamella antevaginalis dumbbell-shaped process with pointed head, dorsally with lamella postvaginalis tongue-shaped process; antrum sclerotized, posterior part broader than anterior. Ductus bursae membranous, anterior to antrum with a small scobinate part; corpus bursae large, ovate; signum large, prominent with horn-like dendrites.

Material examined. [HB] 1 ♂, Mt. Paekdu, 21.VI.1991 (KSS). [GG] 1 ♂, Mt. Keomdan, 23.V.1998 (KSS); 7 ♂, 1 ♀, Gwangleung, 25.VI.1958, 13.V.1972, 14.VI.1975 (KHUS), 31.V.1988 (FRI), 12.VII.1990, 22.VII.1992 (KSS); 1 ♂, 2 ♀, Mt. Chugum, 14.IX.1993; 2 ♂, 1 ♀, Mt. Chonma, 14.VII.1978, 24.VI.1984 (KHUS), 1.VIII.1993 (KSS); 1 ♂, Mt. Koryong, 25.VI.1995 (KSS); 2 ♀, Mt. Paekun, 13.VIII.1989 (KHUS); 3 ♂, 1 ♀, Mt. Soyo, 17.V.1994, 12.VI.1994 (KSS); 1 ♂, Mt. Hwaya, 4.V.1992 (KSS); 1 ♂, Chongpyong, 13.VIII.1972; 6 ♂, 6 ♀, Mt. Myongji, 25.V.1985, 7.VIII.1985, 20.V.1989, 1.VII.1989, 8.VIII.1989, 3.VI.1991 (KHUS); 1 ♂, 2 ♀, Yeoju, 26.VIII.1990 (KSS); [GW] 1 ♀, Gangchon, 15.VI.1974 (KHUS); 4 ♂, Mogok, 20.V.1990, 11.V.1997 (KSS); 3 ♀, Mt. Kwangdeok, 29.VII.1990, 7.VIII.1993 (KHUS); 1 ♂, Yanggu, 3.VIII.1997 (KSS); 20 ♂, 4 ♀, Mt. Sorak, 25–27.V.1983, 11.VI.1983, 11–14.VII.1983, 11.XI.1983; 1 ♂, Mt. Chombong, 8.VIII.1983 (KHUS); 5 ♂, 2 ♀, Mt. Pangtae, 30.VII.1990, 26.VIII.1990, 30.VII.1993; 1 ♂, Mt. Chaean, 28.VI.1998 (KSS); 1 ♂, Wolchongsa, Mt. Odae, 21.VII.1981 (KHUS); 1 ♂, 2 ♀, Mt. Odae, 31.VII.1988, 10.IX.1988 (FRI), 6.VI.1990 (KSS); 1 ♂, Konbongsa, 22.VII.1992; 1 ♀, Mt. Kyebang, 21.VII.1981; 1 ♂, Mt. Sokyejang, 22.VII.1981 (KHUS); 1 ♂, Mt. Kari, 3.VIII.1995 (KSS); 1 ♂, Mt. Kariwang, 25.VII.1987 (KSS); 12 ♂, 3 ♀, Mt. Chiak, 10.VI.1977, 7.VIII.1977, 22.VIII.1977, 17.VIII.1978; 7 ♂, 4 ♀, Mt. Paekdok, 29.V.1981, 4.VII.1981, 6.VIII.1981; 5 ♂, 27.V, 5.VII, 25.VII, 9.VIII.1985 (KHUS, KSS); 5 ♂, Ssangyong, 18.V.1995 (KSS); 52 ♂, 46 ♀, Mt. Taebaek, 4.VIII.1984, 30.IX.1993, 2.VIII.1994, 23.V.1987, 23–26.VI.1987, 23–24.VII.1987. [CN] 2 ♂, 6 ♀, Kapsa, Mt. Kyeryong, 3.VI.1980,

19.VI.1980, 5–8.VIII.1980. [GB] 44 ♂, 32 ♀, Mt. Sobaek, 17.VII.1984, 24–26.V.1985, 16.VII.1985, 6–8.VIII.1985, 6–7.VI.1986, 6–7.VIII.1986; 1 ♂, Mt. Bohyun, 28.VII.1991. [JB] 1 ♂, 3 ♀, Mt. Unjang, 23.VI.1993, 12.VIII.1993; 12 ♂, Kuchondong, Muju, 25–26.VI.1976, 4.VII.1978; 1 ♂, Piagol, Mt. Jiri, 24.VII.1989; 17 ♂, 5 ♀, Bamsagol, Mt. Jiri, 7.VII.1982, 17.VII.1984, 17–19.VIII.1984 (KHUS). [JN] 1 ♂, Mt. Mudeung, 28.V.1994 (KSS); 1 ♀, Mt. Weolchul, 17.VIII.1988 (KHUS). 1 ♂, 10 ♀, Is. Jin, 29.VI.1990, 16.VII.1990 (KHUS). [JJ] 1 ♂, Is. Jeju, 30.VI.1994 (KSS); 1 ♂, 1 ♀, Gwanumsa, 9.VI.1996 (KSS); 1 ♀, Songpanak, 11.VIII.1974 (KHUS); 1 ♂, 1 ♀, Chungmun, 23.VII.1996 (KSS).

Biology. The species is bivoltine and hibernates as a pupa. *Celastrus* and *Tripterygium* (Celastraceae) are known as host plants (Sato and Nakajima, 1987).

Distribution. Korea, Japan, NE. China and Russian Far East.

Remarks. In the present study, the species is the most common species and widely spread in South Korea from Is. Jeju to Mt. Sorak.

***Abraxas fulvobasalis* Warren 점얼룩가지나방**

(Figs 2, 14, 32)

Abraxas fulvobasalis Warren, 1894, Novit. zool. 1: 419.

Abraxas sylvata var. *orientalis* Staudinger, 1897, Dtsch. ent. Z., Iris 10: 24, pl. 1:18; Herz, 1905, Ezheg. zool. Muz. 9: 354; Inoue, 1972, Bull. Fac. domestic Sci., Otsuma Woman's Univ. 8: 149.

Abraxas orientalis: Prout, 1915, in Seitz, Grossschmett. Erde 4: 311, pl. 15: b.

Calospilos orientalis: Inoue, 1956, Check List Lep. Japan 3: 299.

Abraxas (*Calospilos*) *fulvobasalis*: Inoue, 1972, Bull. Fac. domestic Sci., Otsuma Woman's Univ. 8: 149.

Diagnosis. This species, *fulvobasalis*, is nearly indistinguishable from *niphonibia* in the external morphology, but differs in the thick blackish medial band of both fore and hindwings, the thick subterminal band of hindwing, and in the genitalia. In male genitalia the undeveloped ampulla and small harpe, distally bifurcated valva and the absence of distal process in aedeagus separate this species from *niphonibia*.

Redescription. Adults: Wingspan 34–36 mm. Frons broad, brownish; labial palpus short. Legs normal brownish, hindtibia expanded. forewing ground color white; basal part mixed with reddish brown and ochreous bands; medially thick, blackish transverse band; subtermen with two parallel transverse dots, fused to a thick band, with dorsal blotch; termen blackish, centrally expanded. hindwing ground color white; basal part with small black dot; medially black transverse band, costally and centrally expanded, dorsally narrowed; subtermen two parallel transverse dots, fused to thick transverse band; termen thinly blackish, centrally expanded.

Male genitalia. Uncus long, medially membranous, largely expanded, tip slightly expanded; tegumen and vinculum broad; juxta sclerotized, with pit-like invaginations; saccus broad rounded. Valva wider than length, distally bifurcate; costal arm rod-shaped, basally slightly expanded, tip sharp, curved; harpe

greatly reduced, pointed process. Aedeagus rod-shaped, with a caecum, distally sclerotized, without a process.

Female genitalia. Not examined.

Material examined. [GW] 1 ♂, Mt. Pangtae, 26.VIII.1990; 1 ♂, Ssangyong, 20.VI.1998 (KSS).

Biology. The species is bivoltine and hibernates as a pupa. This species is known as a feeder of *Salix* and *Populus* (Salicaceae) (Sato and Nakajima, 1987).

Distribution. Korea, Japan, N. China and Russian Far East (Amur basin, Primorye, S. Kuriles).

Remarks. Inoue (1972) noted that this species is closer to *niphonibia* than *miranda* based on the costal margin of hindwing and the structure of female genitalia. He also commented that the distribution of this species is similar to *sylvata*. The species *fulvobasalis* show the apomorphic state in the male genitalia, the absence of ampulla.

***Abraxas macularia* Herz 무늬 바이 얼룩가지나방**

Abraxas macularia Herz, 1905, Ezheg. zool. Muz. 9: 354.

Remarks. Herz (1905) described a new species, *A. macularia*, based on a female, 7th of July, 1884, from the central part of Korea. He recorded that this new species is close to European species, *A. pantaria* Linneaeus. However, Prout (1915) suspected that this species would be an aberrant form of *sylvata*-group. In the present study we didn't examined the type specimen.

Distribution. Korea.

***Abraxas miranda* Butler 베드나무얼룩가지나방**

(Figs 21–23, 29)

Abraxas miranda Butler, 1878, Ann. Mag. Nat. Hist. (5)1: 441.

Abraxas deminuta Warren, 1894, Novit. Zool. 1: 419; Inoue, 1972, Bull. Fac. domestic Sci., Otsuma Woman's Univ. 8: 155.

Abraxas minax Inoue, 1953, Tinea 1: 7; Inoue, 1972, Bull. Fac. domestic Sci., Otsuma Woman's Univ. 8: 155.

Abraxas orientalis deminita: Prout, 1915, in Seitz, Grossschmett. Erde 4: 311.

Abraxas miranda deminita: Wehrli, 1939, in Seitz, Grossschmett. Erde 4 Suppl. : 289.

Calospilos miranda: Inoue, 1956, Check List Lep. Japan, 3: 299; Lee and Kwon, 1981, Rept. KACN 19: 164.

Calospilos minax: Inoue, 1956, loc. cit.; Kim and Kim, 1972, Rept. KACN 4: 152.

Abraxas (Calospilos) miranda miranda: Inoue, 1972, Bull. Fac. domestic Sci., Otsuma Woman's Univ. 8: 155.

Diagnosis. The species, *miranda*, is indistinguishable from the other species of *Calospilos* s. str. in the external morphology, but differs from *niphonibia* in the termen of hind wing, blackish band centrally

expanded. This species can be separated from *latifasciata* by the structure of male and female genitalia: valvula upturned and projected; harpe with two large projections; aedeagus distodorsally with striations; lamella postvaginalis laterally horseshoe-shaped, centrally grooved; short antrum; and long ductus bursae.

Redescription. Adults: Wingspan 32 mm. Frons broad, brownish; labial palpus short, brown, less than eye diameter in length. Legs normal, covered by brown scales, hindtibia expanded. forewing ground color white; basal part usually with three lines, subbasal and basal lines reddish black, between lines ochreous; medial part costally short, thick black band, dorsally few small dots; subtermen two parallel lines, dorsum with large, reddish black blotch; termen thinly blackish, centrally expanded. hindwing ground color white; basal part with small black dot; submedially with small black dots, often united into one transverse band; subtermen two black parallel transverse dots, forming band, termen with reddish black blotch; termen thinly black, medially slightly expanded.

Male genitalia. Uncus basally greatly tapering, tip expanded; tegumen broad, posteriorly narrowed; saccus broad. Valva sclerotized; costal arm rod-shaped, ventral surface submedially expanded; costa distally upturned, projected; ampulla with small dendrites; harpe well-developed with two large projections. Aedeagus rod-shaped, distally sclerotized, distodorsally striated; caecum long, slender, tip expanded; vesica tubular, without cornutus.

Female genitalia. Papillae anales normal; anterior apophyses half as long as posterior apophyses; lamella postvaginalis laterally horseshoe-shaped, centrally grooved; lamella antevaginalis slightly sclerotized; antrum short, posteriorly broader. Ductus bursae membranous, long; corpus bursae large, ovate; signum rounded, prominent with horn-like dendrites.

Material examined. [GG] 1 ♂, Gwangleung, 2.VIII.1986 (FRI). [GW] 1 ♂, 2 ♀, Mt. Paekdok, 4.VII.1981. [GB] 2 ♂, 2 ♀, Dodong, Is. Ullung, 11.VIII.1971 (KHUS), Is. Ullung, 16.V.1988 (KSS).

Biology. The species is bivoltine or trivoltine and hibernates as a larva or as a pupa, depending on areas (e.g. Korea and Japan). The species feeds *Euonymus japonicus* Thunb. and *E. alatus* Thunb. (Celastraceae) (Sato and Nakajima, 1987).

Distribution. Korea, Japan and NE. China.

Remarks. Inoue (1972) separated this species, *miranda*, from the allied species by the costal-basal protuberance of hindwing.

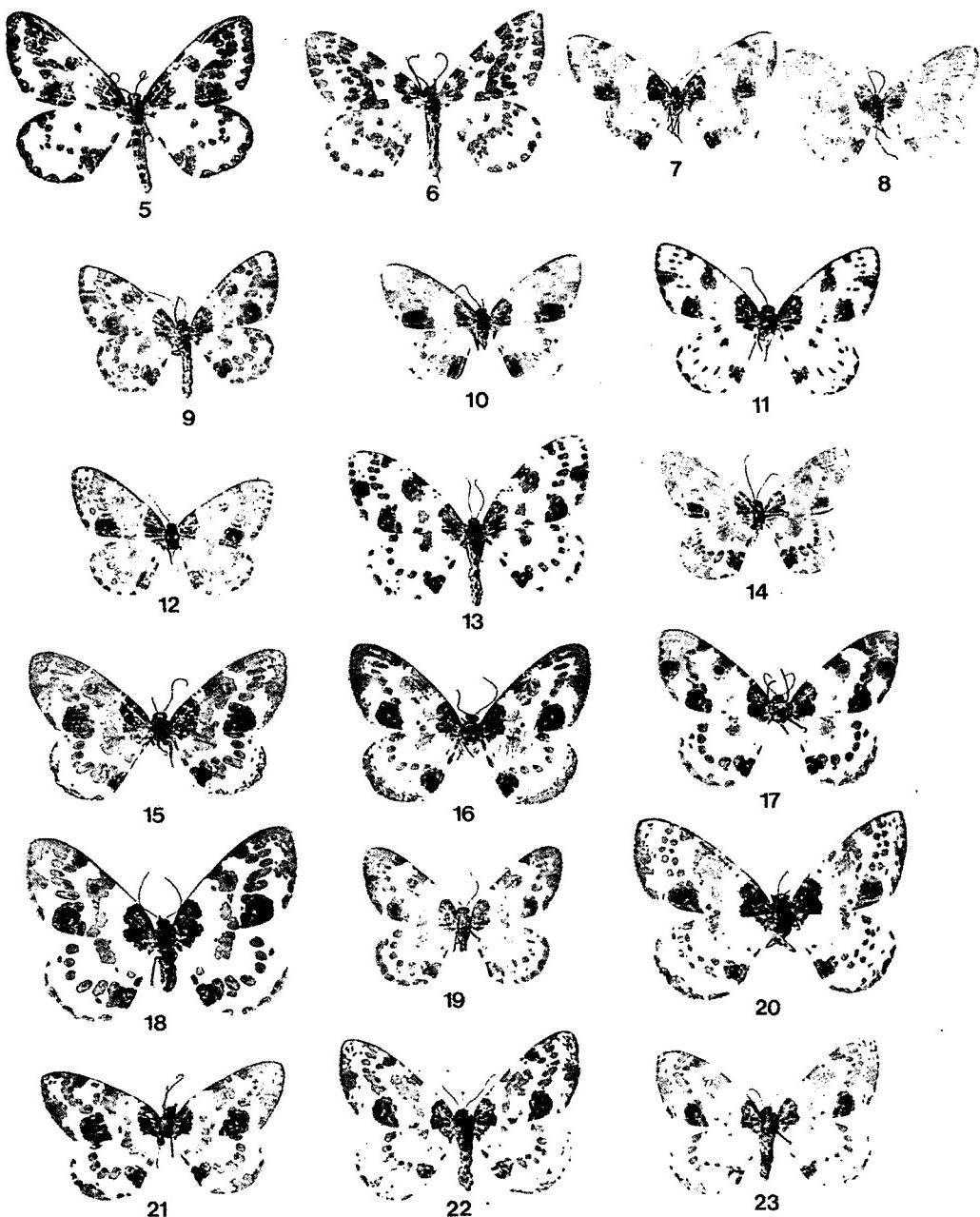
***Abraxas pseudomiranda* sp. nov. 남방얼룩가지나방 (신칭)**

(Figs 20, 33)

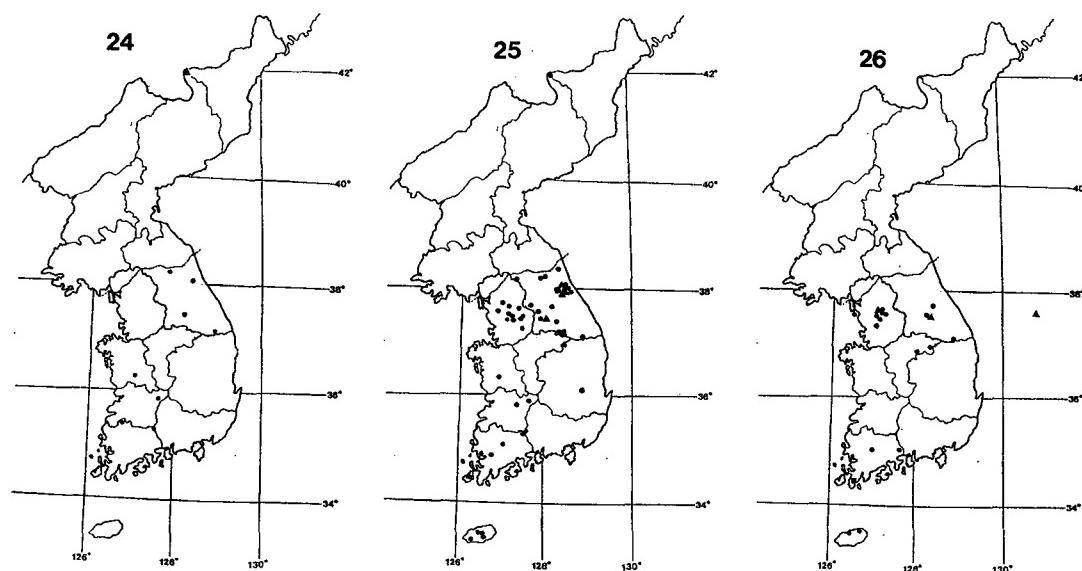
Type. Holotype ♀, JN: Mt. Turyun, 29.V.1994. leg. S.S.Kim. in Department of Biology, Kyung Hee University, Seoul. Type locality: South Korea.

Diagnosis. *A. pseudomiranda* is similar to *miranda* in the wing pattern elements and the female genitalia, but differs in the larger size and the shape of lamella postvaginalis of female genitalia, being ovate with centrally grooves.

Description. Adult: Wingspan 42 mm. Frons broad, reddish black; labial palpus short, being less than



Figs 5-23. Adults of *Abraxas* in Korea: 5-6. *A. grossulariata*; 7-8. *A. sylvata*; 9-13. *A. niphonibia*; 14. *A. fulvobasalis*; 15-19. *A. latifasciata*; 20. *A. pseudomiranda*; 21-23. *A. miranda*.



Figs 24-26. Distribution maps of *Abraxas* in Korea: 24. *A. grossulariata* (●) and *A. karafutonis* (▲); 25. *A. sylvata* (▲), *A. niphonibia* (●), and *A. fulvobasalis* (■); 26. *A. latifasciata* (●), *A. miranda* (▲), and *A. pseudomiranda* (■).

eye diameter. Legs normal, dark brown. forewing ground color white; basal part prominent by reddish black and ochreous bands; medial part with two rows of black dots, irregular shaped; subterminal band lined by two parallel dots, dorsum prominent by large black and ochreous blotch; termen lined by thin, black band. hindwing white; basal part with a black band; medial part with costal black dot and dorsal dot; subterminal band lined by two parallel dots, with a prominent black blotch; termen lined by thin, black band.

Male genitalia. Unknown.

Female genitalia. Papillae anales as in *sylvata*-group; anterior apophyses 2/3 as long as posterior apophyses; sterigma distinct, ventrally with lamella antevaginalis sclerotized, broad, ovate, centrally grooved, dorsally with thinly sclerotized; antrum sclerotized, short, tapering posteriorly. Ductus bursae short, membranous; corpus bursae large, ovate; signum prominent by horn-like dendrites.

Distribution. South Korea.

Etymology. The specific name refers to the closeness to *miranda*.

***Peratophyga* Warren, 1894**

= *Euctenostega* Prout, 1916, Novit. zool. 1: 372 [Synonymized by Holloway, 1993].

Type species. *Acidalia aerata* Moore, 1868, Proc. zool. Soc. Lond., 1867: 643, by original designation. Type locality: [India], Darjeeling.

A. aerata is a junior subjective synonym of *Idaea hyalinata* Kollar, 1848, in Hügel, Kaschmir und das Reich der Siek, 4: 491 (Fletcher, 1979).

Historical review. Prout (1915) diagnosed this genus by the small size and the appearance. He distinguished the genus from *Lomographa* using wing venation, the 2nd subcostal of the forewing stalked, and from *Bapta* or *Cabera* using a character, the 2nd radial of the forewing stalked with the 1st.

Holloway (1993) defined the species group by the two apomorphies: "vein M2 has migrated anteriorly to become stalked with M1 at the anterior angle of the cell separate from the radial system; a distinctive kidney-shaped fovea, concave dorsad, with transverse carinae, situated immediately dorsad from CuA in the cell." He noted that this group spread widely in the Oriental region.

Diagnosis. The genus, *Peratophyga*, can be identified from the above three genera of Abraxini by the smaller size, yellowish wings and the thick light blackish or brownish termen. A species of *Peratophyga* is similar to *Lomaspilis* in the structure of valva, but differs in the other structure of male genitalia.

Distribution. Southeast and Northeast Asia.

Peratophyga hyalinata (Kollar) 검정무늬애기가지나방
(Figs 34, 40)

Idaea hyalinata Kollar, 1848, in Hügel, Kaschmir und das Reich der Siek 4: 491.

Acidalia aerata Moore, 1868, Proc. zool. Soc. Lond. 1867: 643.

Peratophyga hyalinata: Pak, 1969, Moths of Jeju-do and Geoje-do, p. 49.

Ephyra hyalinata grata Butler, 1879, Ann. Mag. nat. Hist. (5)4: 438.

Peratophyga hyalinata grata: Kim, Shin and Kim, 1972, Rept. Sci. Survey Woollung-do, p. 51.

Diagnosis. This species can be identified by the yellowish wing ground color, light blackish basal area and thick blackish termen of wings. It is similar to *Lomaspilis marginata* in the costal part of valva, but differs in the shape of the costal arm that is divided into two arms, the upper arm with a tail, the triangular gnathos with projected apex, and the vesica with a cornutus at the distal part of aedeagus.

Redescription. Adults: Wingspan 21 mm. Frons broad, covered by ochreous scales; labial palpus short, same length as eye diameter. Legs normal, white. forewing ground color yellowish; basal area light black; medially with light blackish dot; termen with thick, light blackish band, inner margin scalloped. hindwing as in forewing, except a medial dot that is absent.

Male abdomen and genitalia. First tergal sclerites large, rod-shaped. Third abdominal sternite with setal comb. Uncus short, triangular, basally with small flap-like projection; gnathos with sides of posterior portion sclerotized and slanting outwardly, then converging to form V-shaped medial projection, apex strongly pointed; tegumen posterior part expanded; juxta broad, basally with posterior processes; saccus broad. Valva simple; costal arm slender, medially bent upper part with pointed tail and hairs, tip sharp; costa medially greatly invaginated; valvula and sacculus forming rod-shaped, elongate arm with tip encurved.

Aedeagus short, membranous, distodorsally with long sclerotized cornutus, distoventrally with sclerotized process; caecum not developed; vesica tubular with small diverticula, surface with minute

scobinations.

Female genitalia. Not examined.

Material examined. [GB] 1 ♂, Is. Ullung, 9.VIII.1971 (KHUS).

Biology. In Japan larva feeds on *Hypericum galiodoides* Lam. (Guttiferae) (Inoue, 1982).

Distribution. Northeast Asia.

Lomaspilis Hübner, 1825

= *Poecilophasia* Stephens, 1831, Illust. Br. Ent. (Haustellata) 3: 314.

= *Lomatospilus* Agassiz, 1847, Nomencl. zool. (Index univl.): 215.

Type species. *Phalaena marginata* Linnaeus, 1758 by subsequent designation by Grote, 1902, Insektenbörse 19: 314. Type locality: Not stated originally, but probably Europe (Fletcher, 1979).

Historical review. Prout (1915) separated the genus *Lomaspilis* from *Abraxas* using the following characters: small size; smooth and glossy abdomen; less strongly dilated hindleg; absence of the 1st subcostal vein of forewing.

Diagnosis. The genus is similar to *Abraxas* and *Ligdia* in male and female genitalia, but differs from *Abraxas* in the medially invaginated costa and spinular cornuti of male genitalia. It also differs from *Ligdia* in the presence of signum of corpus bursae of female genitalia.

Distribution. Palaearctic region.

Lomaspilis marginata (Linnaeus) 고운애기 가지 나방

(Figs 36–37, 39)

Phalaena marginata Linnaeus, 1758, Syst. Nat. (ed. 10) 1: 527.

Abraxas marginata: Staudinger, 1871, in Staudinger and Wocke, Cat. Lep. p. 154.

Abraxas opis amurensis Hedemann, 1875, Horae Soc. Ent. Rossicae XVI: 44, 260.

Lomaspilis opis amurensis: Bryk, 1949, Ark. Zool. 41 A(1): 189.

Lomaspilis marginata amurensis: Inoue, 1946, Bull. lepidopt. Soc. Japan 1(2): 38.

Lomaspilis marginata: Shin, 1983, in Shin, et al., Illustrated Flora and Fauna of Korea 27: 215.

Lomographa marginata: Vojnits et al., 1994, Korean J. Appl. Entomol. 33: 18.

Diagnosis. *Lomaspilis marginata* can be identified by the blackish basal dot of forewing which covers the upper part of radial vein, the large medial dots, often united into one band, and the blackish termen with centrally strongly indented. In male genitalia the well developed gnathos, thick tegumen, distally projected valva, long and medially curved costal arm and the vesica with a large diverticulum and several spinal cornuti are distinguishing characters. In female genitalia the simple, membranous lamella postvaginalis, semi-rounded, sclerotized lamella antevaginalis, short and sclerotized antrum, long and sclerotized ductus bursae and ovate corpus bursae with prominent stellate signum are distinguishing features.

Redescription. Adults: Wingspan 25 mm. Frons covered with brownish scales; labial palpus short. Legs

normal, greyish. forewing ground colour white, basal part blackish, white below radius vein; medial band with large blackish dots, usually separated, but sometimes fused; termen black, variegated, centrally invaginated. hindwing with black medial dots; termen as in forewing.

Male abdomen and genitalia. First tergal sclerites large, triangular. Ansa of tympanal organ apically hooked and pointed. Third abdominal sternite with setal combs. Uncus triangular, tapering, tip with two minute spines; gnathos well developed; tegumen thick; saccus medially projected. Valva simple, distally projected; costa medially deeply invaginated, with long hairs; costal arm long, medially curved, tip sharp. Aedeagus cylindrical, distally strongly sclerotized; vesica large, with diverticulum; cornuti several, large spines.

Female genitalia. Papillae anales normal, sclerotized; anterior apophyses half as long as posterior apophyses; sterigma with semi-rounded and sclerotized lamella postvaginalis and simple and membranous lamella antevaginalis, sometimes centrally projected; antrum short, sclerotized. Ductus bursae sclerotized, with many striations; corpus bursae ovate; signum large, prominent by several dendrites.

Material examined. [GG] 1 ♀, Mt. Whaak, 5.VIII.1989 (KHUS); 1 ♂, Mt. Cheonma, 25.VIII.1989 (KSS). [GW] 1 ♂, Mt. Chiak, 10.VI.1977; 2 ♂, Mt. Paekdok, 4.VII.1981, 3.VII.1985; 2 ♂, 1 ♀, Mt. Taebaek, 25–26.VI.1987, 21.VII.1995 (KHUS, KSS); 2 ♂, Mt. Chaean, 10.VI.1998; 1 ♀, Mt. Odae, 9.VI.1988 (KSS).

Biology. The species is univoltine and hibernates as a pupa. The species is polyphagous (Sato and Nakajima, 1987).

Distribution. Recorded from the Palaearctic region including Korea, Japan, China and Russian Far East (Amur basin, Primorye, S. Kamchatka, Sakhalin).

Ligdia Guénée, 1857

Type species. *Geometra adustata* Denis and Schiffermüller, 1775 by original designation. Type locality: Austria, Vienna district (Fletcher, 1979).

Historical review. Prout (1915) listed the diagnostic characters of the genus *Ligdia* as follows: palpus stronger, 2nd joint longer-scaled above; thorax dorsally less smooth; venation of forewing as in *Abraxas*, but rarely with 1st subcostal vein anastomosing with costal, often with 2nd anastomosing or connected with 3rd–4th; distal margin of hindwing less smooth.

Diagnosis. The member of *Ligdia* is similar to *Abraxas* in the wing pattern elements that forewing basal part is covered with reddish brown and ochreous bands, the subterminal band is blackish and dorsum with slightly reddish brown blotch and the termen is thinly blackish and centrally expanded. However, the genus differs from *Abraxas* in both male and female genitalia: the V-shaped gnathos; distally bifurcated valva; lacking of harpe; presence of cornuti; membranous sterigma; long and sclerotized ductus bursae; absence of signum.

Distribution. Palaearctic region.

***Ligdia japonaria* Leech 흰줄각시 가지나방**

(Figs 35, 38)

Ligdia japonaria Leech, 1897, Ann. Mag. Nat. Hist. (6)19: 449, pl. 7: 1; Min. Education, 1967, The Report of the Academic survey Mt. Sorak, p. 185.

Diagnosis. *Ligdia japonaria* is identified by the medial black dot and subterminal transverse brown band of both fore and hindwings. In male genitalia the V-shaped gnathos, medially projected saccus, distally bifurcated valva, long and medially recurved costal arm and long and cylindrical aedeagus with long spinular cornuti are distinguishing features. In female genitalia simple sterigma, short and weakly sclerotized antrum, slender and sclerotized ductus bursae with transverse striations and membranous and slender corpus bursae without signum are distinguishing.

Redescription. Adults: Wingspan 24–26 mm. Frons simple, covered with brownish scales; labial palpus ochreous, short being the same length as eye diameter. Legs yellowish and covered with brownish dots. Thorax and first abdomen dorsally dark brownish, metathorax with dorsal tufts. forewing ground color white; basally mixed with ochreous and brownish scales; medial part white and prominent by one large brown dot, often several dots; subtermen covered with transverse brown band, subcostally indented; termen whitish, with small brown dots. hindwing whitish; basally with short transverse brown line from dorsum; medial part with brown dot; subtermen thick transverse band; termen white, with dorsally brown dots.

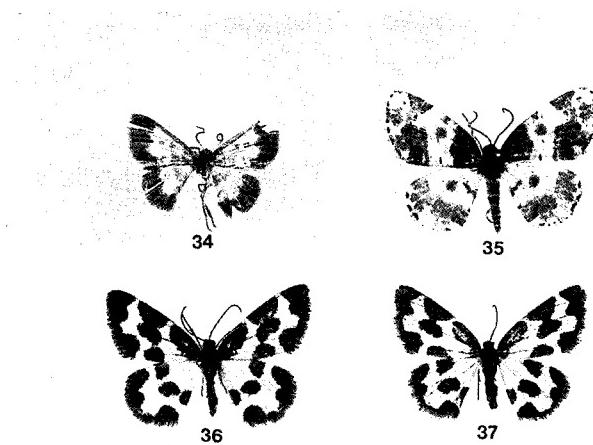
Male abdomen and genitalia. First tergal sclerite large. Third abdominal sternite with setal comb. Uncus basally tapering, triangular, sclerotized; gnathos with sides of posterior portion strongly sclerotized and slanting outwardly, then converging to form elongate V-shaped medial projection, apex terminating in prominent point; tegumen posteriorly thick in width; vinculum bowl-shaped; saccus medially projected. Valva distally bifurcate, with costal arm long, recurved. Aedeagus long, cylindrical, posterior portion oblique, ventrodistally sclerotized; vesica tubular, cornuti long spines.

Female genitalia. Papillae anales normal; anterior apophyses 2/3 of posterior apophyses in length; sterigma simple; antrum weakly sclerotized, short, posterior broader. Ductus bursae long, sclerotized, with transverse striations, posteriorly narrowed; corpus bursae membranous, slender; signum absent.

Material examined. [GG] 1 ex., Gwangleung, 10.V.1975; 1 ♂, Mt. Whaak, 24.VI.1989. [GW] 3 ♂ 1 ♀, Mt. Sorak, 24–26.V.1983, 11.VI.1983 (KHUS); 1 ♀, Mt. Kwangdeok, 30.V.1994; 1 ♀, Mt. Kari, 9.VII.1995 (KSS). [CN] 1 ♂, Kapsa, Mt. Kyeryong, 8.VIII.1980. [GB] 1 ♂, Mt. Sobaek, 6.VI.1986. [JB] 1 ♂, Kuchondong, Muju, 26.VI.1976; 1 ♂, Piagol, Mt. Chiri, 10.VII.1982 (KHUS); 1 ♂, Mt. Daedun, 23.V.1992 (KSS).

Biology. The species is bi- or trivoltine and hibernates as a pupa. For host plant, the species feeds on *Euonymus* spp. (Celastraceae) (Sato and Nakajima, 1987).

Distribution. Korea and Japan.



Figs 34-37. Adults of Abraxini in Korea.: 34. *Peratophyga hyalinata*; 35. *Ligdia japonaria*; 36-37. *Lomaspilis marginata*.

***Ligdia adustata* (Denis and Schiffermüller)** 밀검은각시가지나방

Geometra adustata Denis and Schiffermüller, 1775, Wien Ver. 1775: 114.

Ligdia adustata: Vojnits et al., 1994, Korean J. Appl. Entomol. 33: 18.

Remarks. In Korea this species was first recorded by Vojnits et al. (1994) using a female from Mt. Kumgang (4-6.VIII.1975). However, the record of this species in Korea is ambiguous. It is mainly known from the central and southern Europe and the external appearance of this species is similar to *L. japonaria*.

In addition Beljaev and Park (1998) described a new species, *Ninodes albarius*, and they synonymized *N. albarius* with the record of *Ligdia adustata* in Korea. Therefore, we consider that this species does not occur in Korea.

Distribution. Only known from the central and southern Europe.

***Heterostegane* Hampson, 1893**

= *Liposchema* Warren, 1914, Ann. S. Afr. Mus. 10: 494.

= *Chrostobapta* Warren, 1907, Novit. zool. 14: 164 [Synonymized by Holloway, 1993].

Type species. *Macaria subtessellata* Walker, 1863, List Specimens lepid. Insects Colln Br. Mus., 26: 1648, by original designation. Type locality: India, Kanara (Fletcher, 1979).

Historical review. Prout (1915) divided the genus *Lomographa* Hübner into two groups, *Heterostegane* Hampson and *Lomographa* s. str., using the shape of male antenna. The common features of

Lomographa s. lat. are similar to *Abraxas*: smooth face, short palpi, forewing with the 1st and 2nd subcostals coincident, and absence of fovea. He listed two species, *cararia* Hübner and *hyriaria* Warren, under *Heterostegane*. Both species have a ciliated male antenna.

Holloway (1993) commented that the group is mainly Old-World tropical, but extends into the Palaearctic region. He suggested that the venation of forewing is the typical of the tribe and the presence of strong furca at the basal part of juxta in male genitalia is a distinguishing feature.

Diagnosis. The genus *Heterostegane* is similar to *Peratophyga* in the wing pattern elements and the male genitalia, but it can be identified by the reddish black or brownish subterminal line of forewing and the relatively long uncus, the absence of gnathos, the short costal arm and the long, well-developed furca of male genitalia.

Distribution. Oriental and Palaearctic region, but most diverse in the Oriental region.

***Heterostegane hyriaria* Warren 네무늬 가지나방**

(Fig. 41)

Heterostegane hyriaria Warren, 1894, Novit. zool. 1: 406.

Stegania irroraria Leech, 1897, Ann. Mag. nat. Hist. (6)19: 203; Prout, 1915, in Seitz, Die Grossschmett. Erde 4: 316.

Lomographa hyriaria: Prout, 1915, in Seitz, Die Grossschmett. Erde 4: 316.

Diagnosis. *Heterostegane hyriaria* can be identified by the smaller size, the yellowish white wing color, and the prominent subterminal line of forewing. This species is similar to the following species, *H. cararia*, in the wing pattern elements, but differs in the well-developed furca, short and slender costal arm and the small projected ampulla and harpe of male genitalia.

Redescription. Adults: Wingspan 21 mm. Frons broad, covered by ochreous and yellowish white scales; labial palpus short, being less than eye diameter. Legs normal, yellowish. forewing ground color yellowish white; costa thinly lined by brown; antemedial line weak, brown, with a brown discal dot; subterminal line prominent, brown, centrally extended to termen. hindwing as in forewing, with termen lined by brown.

Male abdomen and genitalia. Third abdominal sternite without setal combs. Uncus long, basally tapering; gnathos absent; tegumen short, vinculum broad, elongate, with medially projected saccus; furca long, strongly sclerotized, starting from saccus and medially connected juxta; juxta sclerotized, narrowed at base. Valva with slender costal arm, arising from the base of uncus; ampulla projected process; harpe thinly projected; distal part of valva (valvula) projected with tip upturned. Aedeagus distal half strongly sclerotized; vesica tubular, distally expanded with long cornutus.

Female genitalia. Not examined.

Material examined. [CN] 1 ♂, Kumgang, 25.V.1986 (KSS).

Distribution. Korea, Japan, and NE. China.

Biology. Larva feeds on *Prunus yedoensis* Matsumura and *P. serrulata* var. *spontanea* Wils. (Rosaceae) (Inoue, 1982).

***Heterostegane cararia* Hübner** 네 눈 애기 가지 나방

(Fig. 42)

Phalaena cararia Hübner, 1790, Beitr. Gesch. Schmett. 2(3): 77, pl. 4: X.

Lomographa cararia: Prout, 1915, in Seitz, Die Grossschmett. Erde 4: 316.

Heterostegana cararia: Oh and Park, 1989, Jour. Sci. Tech., Kangweon Nat'l Univ. 27: 352.

Diagnosis. *H. cararia*, is similar to *H. hyriaria* in the wing pattern elements, but differs in having the subterminal line of hindwing, the presence of setal combs on male's third abdominal sternite, the long and medially curved costal arm and the claw-like cornutus and many spinular cornuti of vesica of male genitalia.

Adult: Wingspan 19–21 mm. For descriptions of the external appearance, male and female genitalia, see Oh and Park (1989).

Material examined. [GG] 1 ♂, Mt. Chean, 31.V.1998; 1 ♂, Duekgok-ri, Yanggu, 2.VIII.1997. [CB] 1 ♀, Mt. Songni, 5.V.1994 (KSS).

Distribution. Korea, Russian Far East, N. China, Central Asia, SE. European Russia.

Remarks. Oh and Park (1989) first recorded the species from Korea using one male from Sogumgang, Kangwon Prov. (7.VII.1988) and one female from Gwangleung, Kyunggi Prov. (31.V.1988).

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REFERENCES

- Beljaev, E.A. and K.T. Park. 1998. New and little known Ennominae (Lepidoptera, Geometridae) from Korea and Russian Far East, with descriptions of three new species. *Tinea* 15: 243–255.
- Farris, J.S. 1969. A successive approximations approach to character weighting. *Syst. Zool.* 18: 374–385.
- Farris, J.S. 1988. *Hennig86*. Ver. 1.5. Port Jefferson Station, New York.
- Fletcher, D.S. 1974. A revision of the Old World genus Zamarada (Lepidoptera: Geometridae). *Bull. Br. Mus. nat. Hist. (Ent.) Suppl.* 22.
- Fletcher, D.S. 1979. Geometroidea. In Nye, I.W.B. (ed.) *The generic names of moths of the world*. Vol. 3. Trustees of the British Museum (Natural History), London.
- Forbes, W.T.M. 1948. Lepidoptera of New York and neighboring states. Part II. *Cornell Univ. Agric. Exp. Stat. Mem.*, 274: 5–263.
- Goloboff, P.A. 1993. NONA. Ver. 1.5. San Miguel de Tucuman.
- Hardwick, D.F. 1950. Preparation of slide mounts of lepidopterous genitalia. *Can. Entomol.* 82: 231–235.
- Herbulot, C. 1961–62. Mise à jour de la liste des Geometridae de France. *Alexanor* 2: 117–124, 147–154.
- Herz, O. 1905. Lepidoptera von Korea. Noctuidae und Geometridae. *Ezheg. zool. Muz.* 9: 332–375.

- Holloway, J.D. 1993. *The moths of Borneo*. Part 11. Geometridae. Ennominae. The Malaysian Nature Society, Kuala Lumpur.
- Inoue, H. 1946. Notes on some Geometridae. *Bull. lepidop. Soc. Japan* 1: 1-22.
- Inoue, H. 1970. Geometridae of eastern Nepal based on the collection of the lepidopterological research expedition to Nepal Himalaya by the lepidopterological society of Japan in 1963. Part I: Genera *Abraxas* Leach and *Arichanna* Moore. *Spec. Bull. Lep. Soc. Jap.* 4: 203-239.
- Inoue, H. 1972. The genus *Abraxas* of Japan, Korea, Saghalien and Manchuria (Lepidoptera, Geometridae). *et al. Bull. Fac. domestic Sci., Otsuma Woman's Univ.* 6: 141-163, pls 13.
- Inoue, H. 1982. Geometridae. In Inoue, H. et al. (eds.) *Moths of Japan*. Kodansha, Tokyo.
- Inoue, H. 1984. The genus *Abraxas* of Taiwan (Lepidoptera, Geometridae). *Bull. Fac. domestic Sci., Otsuma Woman's Univ.* 20: 93-128.
- Inoue, H. 1992. Geometridae. In Heppner, J.B., and Inoue, H. (eds.), *Lepidoptera of Taiwan*. Vol. 1, part 2. Association for Tropical Lepidoptera, Gainesville.
- Inoue, H. 1995. The genera *Abraxas* and *Ourapteryx* from Nepal (Geometridae, Ennominae). In Haruta, T. (ed.) *Moths of Nepal*. Part 4. *Tinea* 14 Suppl., 2: 119-139.
- Kim, C.W. et al. 1975. Faunistic study of insects near the DMZ. *Rept. KACN* 7: 213-214.
- Oh, S.H. and K.T. Park. 1989. Newly recorded species of Macrolepidoptera from Korea (II). - Nine species of Geometridae-. *Jour. Sci. Tech., Kangweon Nat'l Univ.*, 28: 351-359.
- Park, K.T. and S.S. Han. 1992. Insect fauna of Mt. Palwang. *Rept. KACN* 30: 132-133.
- Prout, L.B. 1915. Geometrinae. In Seitz, A. (ed.), *The Macrolepidoptera of the world*. pp. 303-316. Verlag, Stuttgart.
- Sato, R. and Nakajima, H. 1987, Geometridae. In Sugi, S. (ed.), *Larvae of larger moths in Japan*. Kodansha, Tokyo.
- Shin, Y.H. 1996. *Synonymic list and distribution of the Geometridae of Korea (Lepidoptera)*. Center for Insect Systematics, Chuncheon.
- Viidalepp, J. 1996. *Checklist of the Geometridae (Lepidoptera) of the former U.S.S.R.* Apollo Books, Stenstrup.
- Vojnits, A., K.T. Park, and Y.H. Shin. 1994. New faunistic data on the family Geometridae (Lepidoptera) of the Korean Peninsula. *Korean J. Appl. Entomol.* 33: 16-18.
- Wehrli, E. 1939. Geometridae. In Seitz, A. (eds.), *Die Gross-Schmetterlinge der Erde* 4. Supplement. Verlag, Stuttgart.

韓國產 Abraxini族 (Lepidoptera, Geometridae, Ennominae)의 분류학적 정리

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American Museum of Natural History, New York,

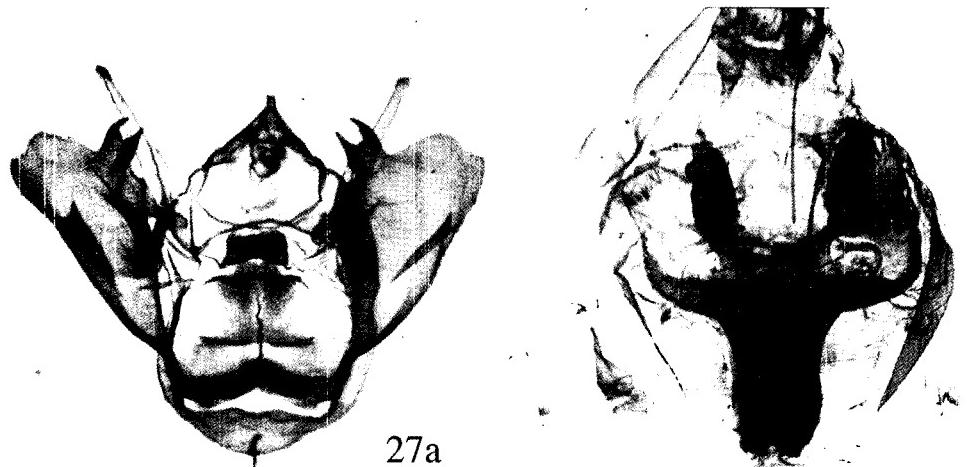
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이번 연구는 한국산 Abraxini족에 속하는 5속 12종의 분류학적 연구이다. 이들 속 및 종은 *Abraxas* Leach의 7종 (*grossulariata* Linnaeus, *sylvata* Scopoli, *niphonibia* Wehrli, *fulvobasalis* Warren, *latifasciata* Warren, *miranda* Butler, and *pseudomiranda* sp. nov.), *Ligdia* Guenée의 1종 (*japonaria* Leech), *Lomaspilis* Guenée의 1종 (*marginata* Linnaeus), *Peratophyga* Warren의 1종 (*hyalinata* Kollar) 및 *Heterostegane* Hampson의 2종 (*hyriaria* Warren and *cararia* Hübner)이다. 한국산 Abraxini에 대한 분지론적 분석이 11개의 분류군과 29개의 형태학적 형질을 이용하여 이루어졌다. 그 결과 한 개의 계통도를 선택하였는데 이 계통도내의 속간의 유연관계는 다음과 같다 (*Eutoea* (*Heterostegane hyriaria* (*Ligdia* (*Lomaspilis*, *Heterostegane cararia*))), (*Peratophyga*, *Abraxas*)). Abraxini 족 및 4속 (*Abraxas*, *Lidia*, *Lomaspilis* 및 *Peratophyga*)의 단계통성과 이들간의 상호유연관계를 논의하였다. 그리고 분석결과 한 속 *Heterostegane*는 단계통성군이 아님이 밝혀졌다. 그 밖에 *Abraxas*속 7종의 한국내 분포를 도식화하였다.

검색어 : 나비목, 자나방과, 가지나방아과, Abraxini족, *Abraxas*속, *Ligdia*속, *Lomaspilis*속, *Peratophyga*속, *Heterostegane*속, 한국

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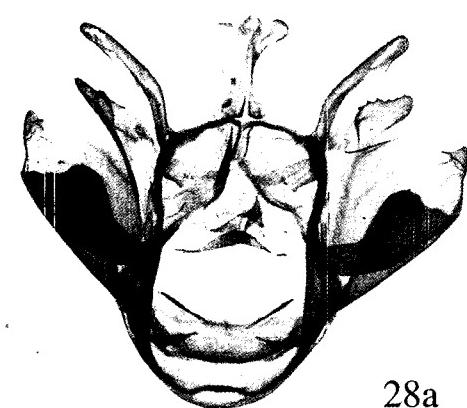
27a



27b



27c



28a

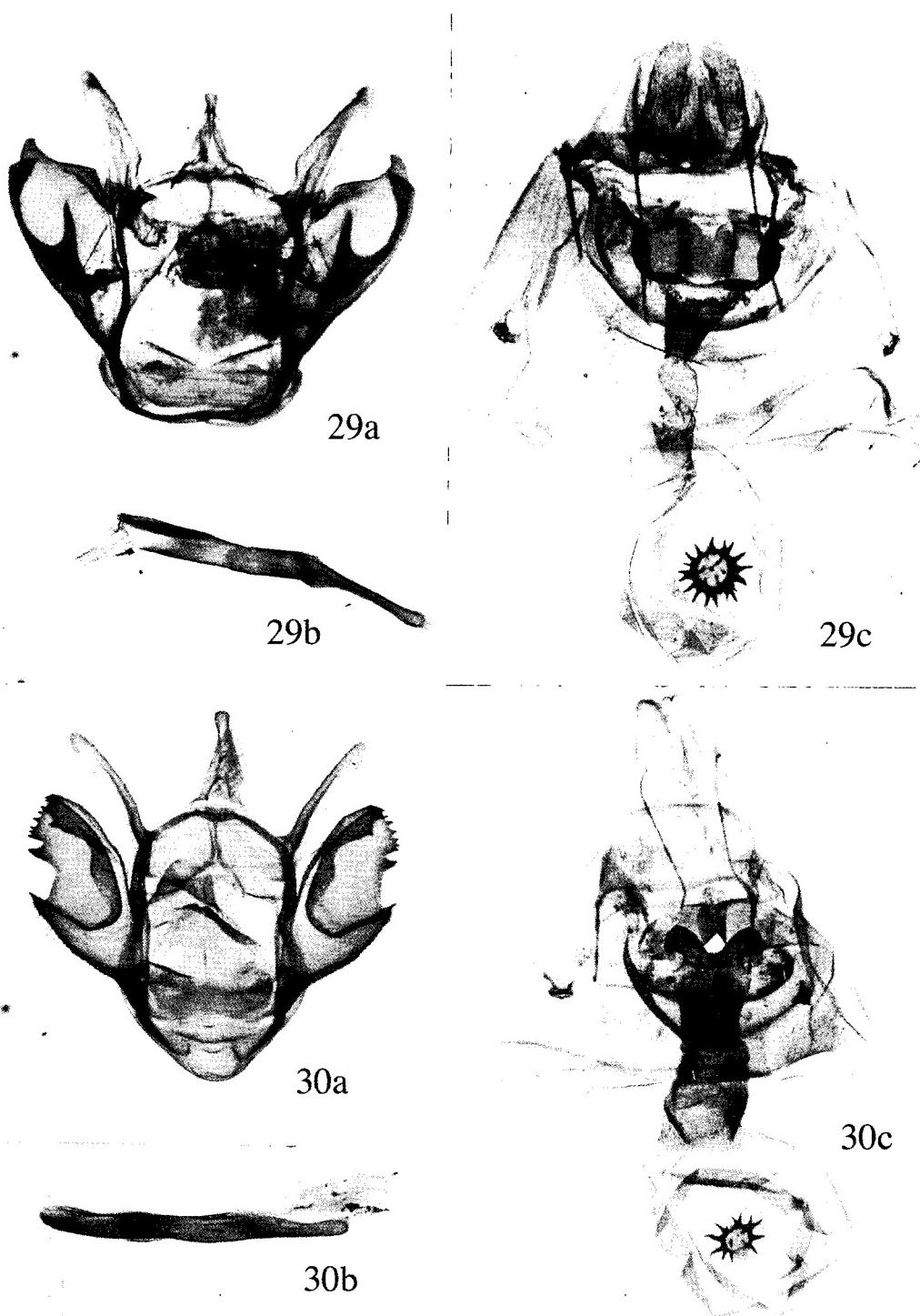


28b

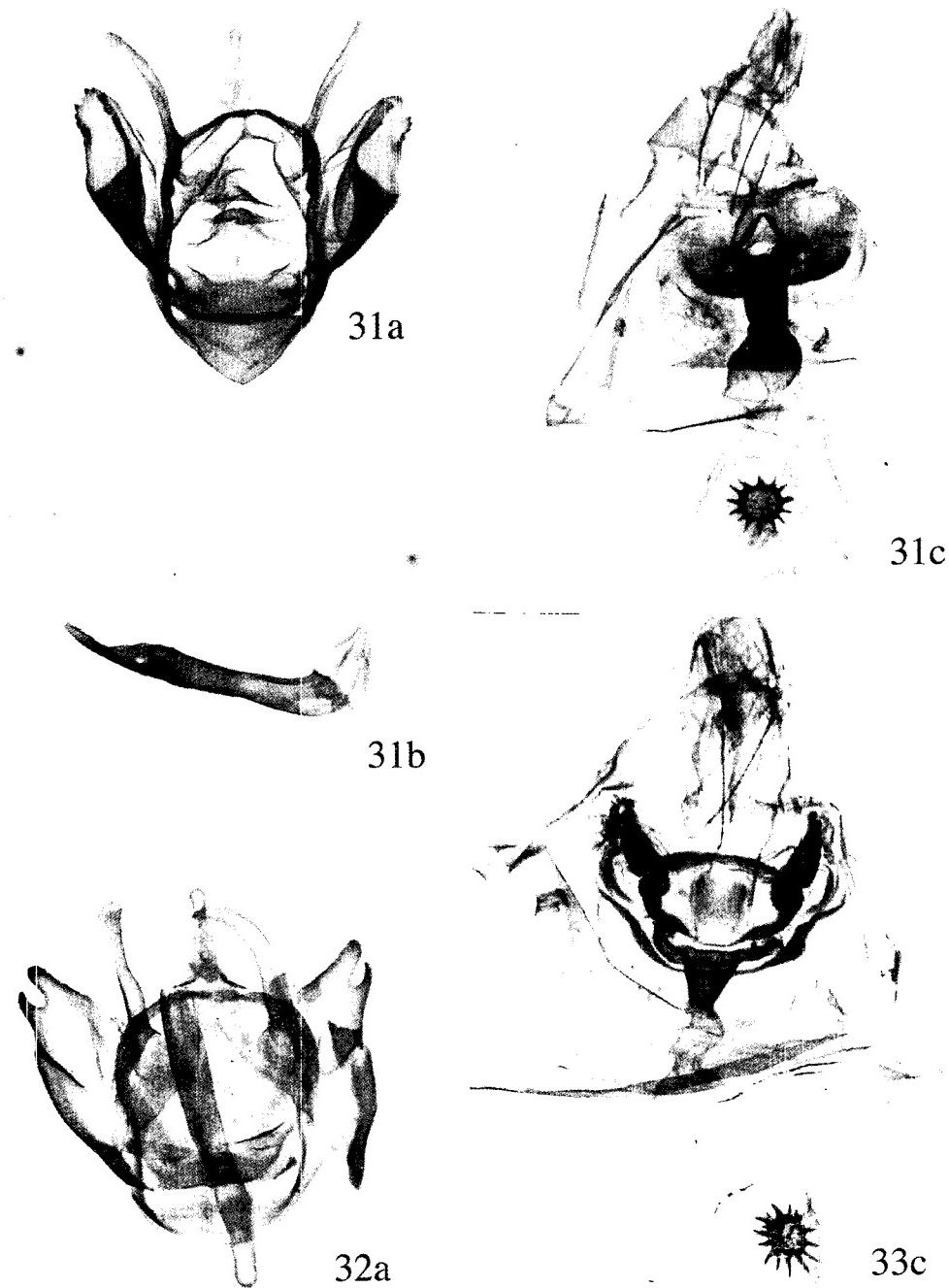


28c

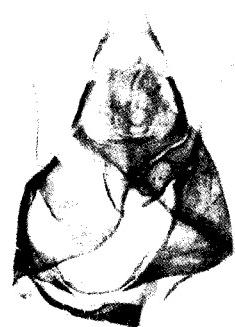
Figs 27-28. Male and female genitalia of *Abraxas* in Korea. a. male genital capsule; b. aedeagus with everted vesica; c. female genitalia: 27. *A. grossulariata*; 28. *A. latifasciata*.



Figs 29-30. Male and female genitalia of *Abraxas* in Korea. a. male genital capsule; b. aedeagus with everted vesica; c. female genitalia: 29. *A. miranda*; 30. *A. sylvata*.



Figs 31-33. Male and female genitalia of *Abraxas* in Korea. a. male genital capsule; b. aedeagus with everted vesica; c. female genitalia: 31. *A. niphonibia*; 32. *A. fulvobasalis*; 33. *A. pseudomiranda*.



38a



38b



39a



39b

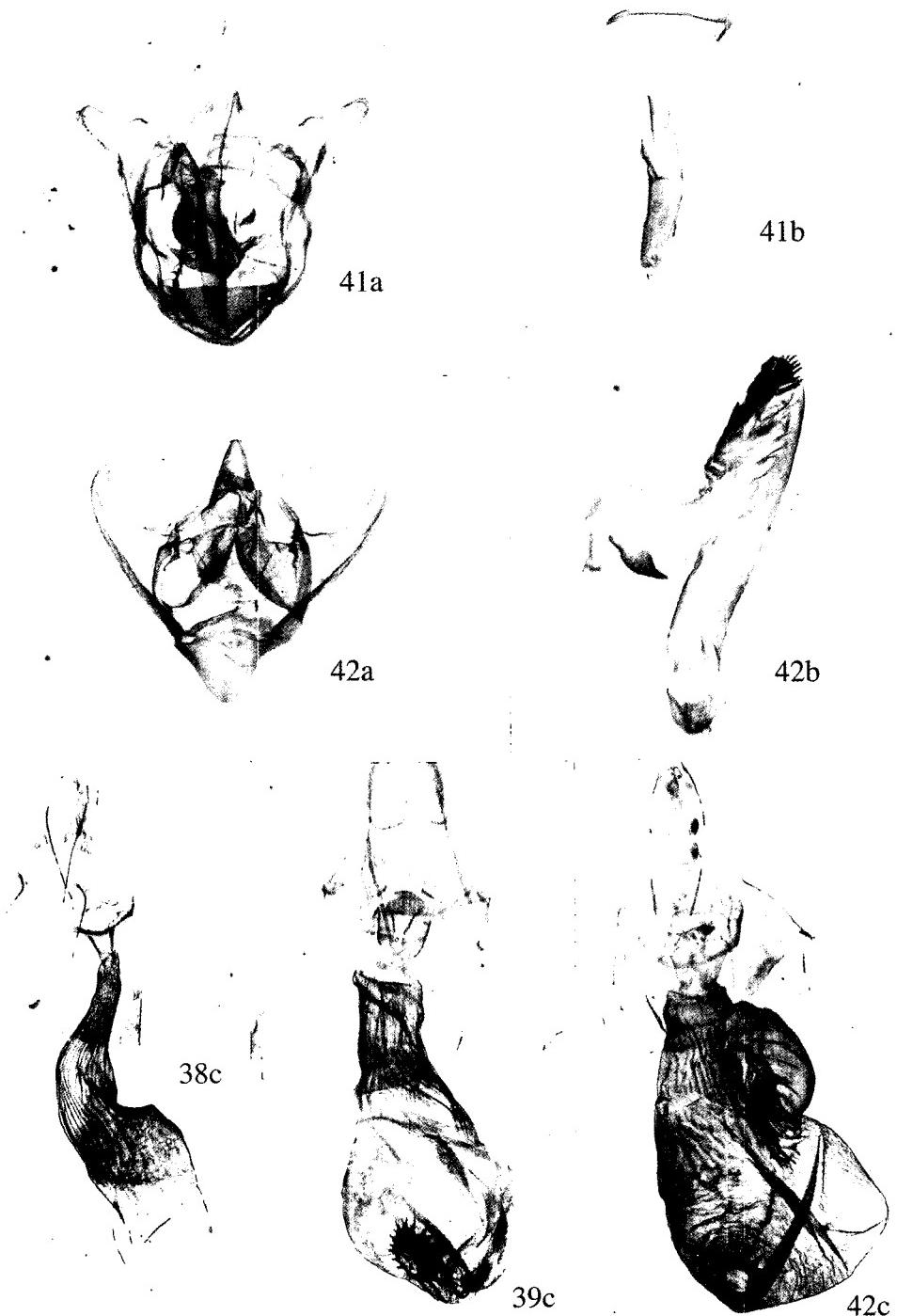


40a



40b

Figs 38-40. Male and female genitalia of Abraxini in Korea. a. male genital capsule; b. aedeagus with everted vesica;
c. female genitalia: 38. *Ligdia japonaria*; 39. *Lomaspilis marginata*; 40. *Peratophyga hyalinata*.



Figs 41-42. Male and female genitalia of Abraxini in Korea. a. male genital capsule; b. aedeagus with everted vesica; c. female genitalia: 41. *Heterostegane hyriaria*; 42. *H. cararia*.

Appendix 1. A list of characters and character states of the tribe Abraxini in South Korea. 29 morphological characters were used in the analysis. Each character is accompanied by the total steps, consistency index and retention index in the best cladogram.

0. Male forewing fovea present (0); absent (1). (2 steps, ci 50, ri 50)
1. Male abdominal sternite without setal combs (0); with setal combs (1). (2 steps, ci 50, ri 0)
2. forewing basal area prominent by blackish and yelloish bands (0); by black, horizontal bar (1); not prominent (2). (3 steps, ci 66, ri 75)
3. Wings medial part with blackish dots or band (0); without band or dot (1). (3 steps, ci 33, ri 33)
4. Termen of forewing with thick, blackish band (0); not prominent (1). (2 steps, ci 50, ri 0)
5. Tibia of hindlegs normal (0); expanded (1). (1 step, ci 100, ri 100)
6. Adomen normal, without distinguishing black dots (0); with dots (1). (2 steps, ci 50, ri 80)
7. forewing subterminal band normal, not prominent (0); with yellowish blotch or prominent (1). (2 steps, ci 50, ri 80)
8. Uncus tip expanded (0); sharp (1); bifurcate (2). (2 steps, ci 100, ri 100)
9. Uncus basally normal without process (0); with process (1); with flap-like projections (2). (4 steps, ci 50, ri 0)
10. Gnathos present with triangular (0); with ring-shaped (1); absent (2). (3 steps, ci 66, ri 0)
11. Tegumen shorter than vinculum in length (0); well-developed, longer (1). (1 step, ci 100, ri 100)
12. Juxta basal part with normal (0); with pit-like invagination or process (1). (1 step, ci 100, ri 100)
13. Saccus broad, rounded (0); medially strongly projected (1); transformed with the strong furca (2). (4 steps, ci 50, ri 50)
14. Valva costal arm straight, rod-shaped (0); medially strongly encurved (1); medially encurved, upper part with a tail (2); absent (3). (3 steps, ci 100, ri 100)
15. Costal margin flat (0); invaginated (1). (4 steps, ci 25, ri 25)
16. Valva costa normal without process (0); with a basal process (1); with a distal process (2). (2 steps, ci 100)
17. Valvula normal, without dentate process (0); with dentate processes (1). (1 step, ci 100, ri 100)
18. Ampulla absent (0); well-developed with dentate processes (1). (3 steps, ci 33, ri 50)
19. Harpe not developed (0); with a process (1); with two processes (2). (3 steps, ci 66, ri 80)
20. Aedeagus rod-shaped without caecum (0); with well-developed long caecum (1). (1 step, ci 100, ri 100)
21. Aedeagus distally normal without process (0); with a process (1). (2 steps, ci 100, ri 100)
22. Vesica tubular (0); large, sac-like (1). (2 steps, ci 50, ri 0)
23. Cornutus absent (0); one, large spinular (1); several, large spinular (2); several, small processes (3). (4 steps, ci 75, ri 75)
24. Lamella postvaginalis simple, membranous (0); sclerotized without process (1); with a small process (2); with a large process (3). (4 steps, ci 75, ri 50)
25. Lamella antevaginalis simple, membranous (0); sclerotized without process (1); with a small process (2); with a large process (3). (3 steps, ci 100, ri 100)
26. Antrum short, not strongly sclerotized (0); short, but strongly sclerotized (1); long, strongly sclerotized (2). (2 steps, ci 100, ri 100)
27. Ductus bursae long, sclerotized with many striations (0); short, membranous (1); long, inner wall with sclerite process (2). (2 steps, ci 100, ri 100)
28. Male antenna bipectinate (0); filiform (1). (1 step, ci 100)

Appendix 2. Data matrix for cladistic analysis of the tribe Abraxini in Korea. *Gonodontis clelia* Cramer and *Eutoea heteroneurata* Guenée were used as the outgroup. Missing characters due to the lack of specimen are shown as hyphens (-). Characters and character states are shown in the Appendix 1. Generic abbreviations are as follows: Go. *Gonodontis*; E. *Eutoea*; A. *Abraxas*; Li. *Ligdia*; Lo. *Lomaspilis*; P. *Peratophyga*; and H. *Heterostegane*.

Taxa	Characters
	01234567891111111112222222222
	0123456789012345678
Go_clelia	01201-0010210130000001300200
E_heteroneurata	01201-00102100002000000200001
A_grossulariata	11001110122110001011100012211
A_sylvata	11001111002111000111110033111
A_niphonibia	11001111002111000111110023111
A_latifasciata	11001111012110010011100002211
A_miranda	11001111002110000002100011111
A_fulvobasalis	11001111002110000001100023111
Li_japonaria	11011011100000100000000200001
Lo_marginata	111000000101001110000001200001
P_hyalinata	012100001201102100000203----1
H_hyriaria	102110001020020100110001----1
H_cararia	11211000222001110000000300021